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YAMAHA

F90D

SERVICE MANUAL

LIT-18616-02-86

6D8-28197-1G-11

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NOTICE

This manual has been prepared by Yamaha primarily for use by Yamaha dealers and their trained mechanics when performing maintenance procedures and repairs to Yamaha equipment. It has been written to suit the needs of persons who have a basic understanding of the mechanical and electrical concepts and procedures inherent in the work, for without such knowledge attempted repairs or service to the equipment could render it unsafe or unfit for use.

Because Yamaha has a policy of continuously improving its products, models may differ in detail from the descriptions and illustrations given in this publication. Use only the latest edition of this manual. Authorized Yamaha dealers are notified periodically of modifications and significant changes in specifications and procedures, and these are incorporated in successive editions of this manual.

Important information

Particularly important information is distinguished in this manual by the following notations:

⚠ The Safety Alert Symbol means ATTENTION! BECOME ALERT! YOUR SAFETY IS INVOLVED!

⚠ WARNING

Failure to follow WARNING instructions could result in severe injury or death to the machine operator, a bystander, or a person inspecting or repairing the outboard motor.

CAUTION:

A CAUTION indicates special precautions that must be taken to avoid damage to the outboard motor.

NOTE:

A NOTE provides key information to make procedures easier or clearer.

F90D
SERVICE MANUAL
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Contents

General information	GEN INFO	1
Specifications	SPEC	2
Periodic checks and adjustments	CHK ADJ	3
Fuel system	FUEL	4
Power unit	POWR	5
Lower unit	LOWR	6
Bracket unit	BRKT	7
Electrical systems	ELEC	8
Troubleshooting	TRBL SHTG	9
Index		

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General information

How to use this manual 1-1
Manual format 1-1
Symbols 1-2

Safety while working 1-3
Fire prevention 1-3
Ventilation 1-3
Self-protection 1-3
Parts, lubricants, and sealants 1-3
Good working practices 1-4
Disassembly and assembly 1-4

Identification 1-5
Applicable model 1-5
Serial number 1-5

Propeller selection 1-5
Propeller size 1-5
Selection 1-6

Predelivery checks 1-6
Checking the fuel system 1-6
Checking the engine oil level 1-6
Checking the gear oil level 1-7
Checking the battery 1-7
Checking the outboard motor mounting height 1-7
Checking the remote control cables 1-7
Checking the steering system 1-8
Checking the gear shift and throttle operation 1-8
Checking the power trim and tilt system 1-8
Checking the engine start switch and engine stop lanyard switch 1-8
Checking the cooling water pilot hole 1-9
Test run 1-9
Break-in 1-9
After test run 1-9

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How to use this manual

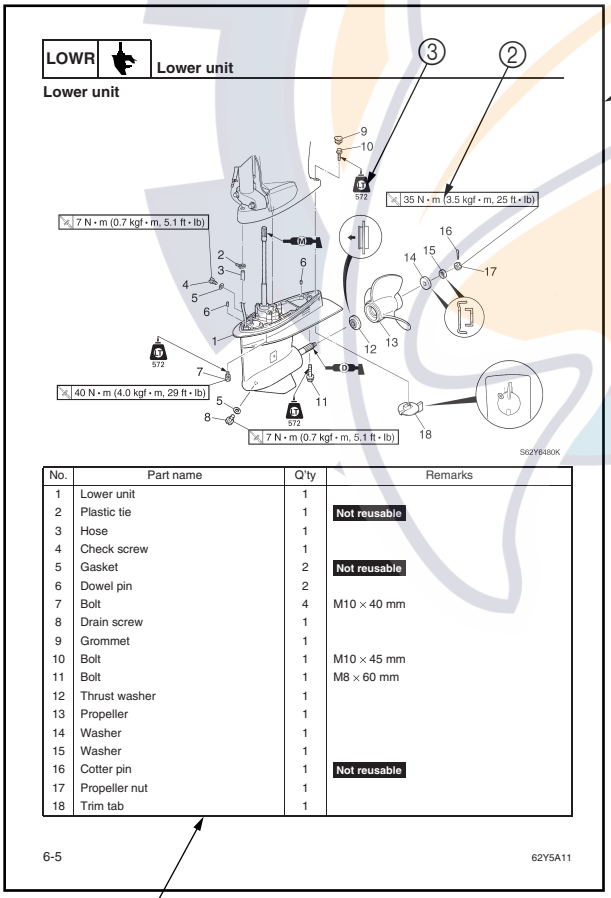
Manual format

The format of this manual has been designed to make service procedures clear and easy to understand. Use the information below as a guide for effective and quality service.

① Parts are shown and detailed in an exploded diagram and are listed in the components list.
② Tightening torque specifications are provided in the exploded diagrams and after a numbered step with tightening instructions.
③ Symbols are used to indicate important aspects of a procedure, such as the grade of lubricant and lubrication point.
④ The components list consists of part names and part quantities, as well as bolt and screw dimensions.
⑤ Service points regarding removal, checking, and installation are shown in individual illustrations to explain the relevant procedure.

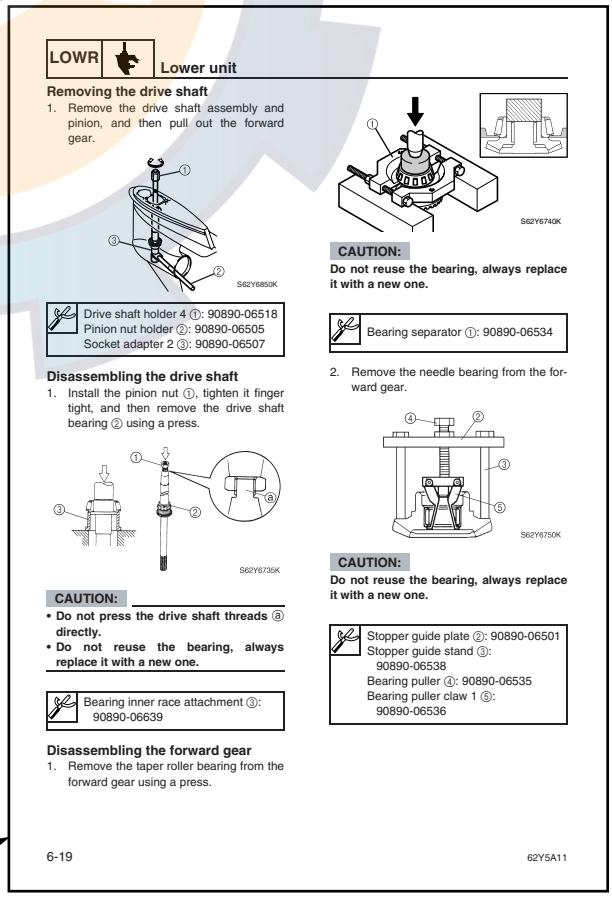
NOTE:

For troubleshooting procedures, see Chapter 9, “Troubleshooting.”



No.	Part name	Q'ty	Remarks
1	Lower unit	1	
2	Plastic tie	1	Not reusable
3	Hose	1	
4	Check screw	1	
5	Gasket	2	Not reusable
6	Dowel pin	2	
7	Bolt	4	M10 × 40 mm
8	Drain screw	1	
9	Grommet	1	
10	Bolt	1	M10 × 45 mm
11	Bolt	1	M8 × 60 mm
12	Thrust washer	1	
13	Propeller	1	
14	Washer	1	
15	Washer	1	
16	Cotter pin	1	Not reusable
17	Propeller nut	1	
18	Trim tab	1	

6-5 62Y5A11


LOWR
Lower unit
Removing the drive shaft
1. Remove the drive shaft assembly and pinion, and then pull out the forward gear.
S62Y6850K
Drive shaft holder 4 ①: 90890-06518
Pinion nut holder ②: 90890-06505
Socket adapter 2 ③: 90890-06507
Disassembling the drive shaft
1. Install the pinion nut ①, tighten it finger tight, and then remove the drive shaft bearing ② using a press.
S62Y6735K
CAUTION:
• Do not press the drive shaft threads ⓐ directly.
• Do not reuse the bearing, always replace it with a new one.
Bearing inner race attachment ③: 90890-06639
Disassembling the forward gear
1. Remove the taper roller bearing from the forward gear using a press.
S62Y6740K
CAUTION:
Do not reuse the bearing, always replace it with a new one.
Bearing separator ①: 90890-06534
2. Remove the needle bearing from the forward gear.
S62Y6750K
CAUTION:
Do not reuse the bearing, always replace it with a new one.
Stopper guide plate ②: 90890-06501
Stopper guide stand ③: 90890-06538
Bearing puller ④: 90890-06535
Bearing puller claw 1 ⑤: 90890-06536
6-19 62Y5A11

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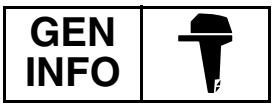
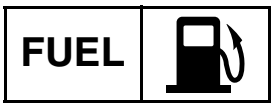
Symbols

The symbols below are designed to indicate the content of a chapter.

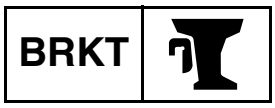
General information



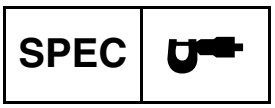
Fuel system



Bracket unit

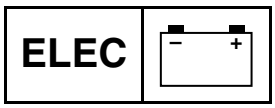


Specifications

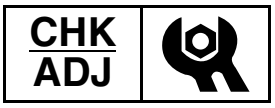


Power unit

Electrical systems



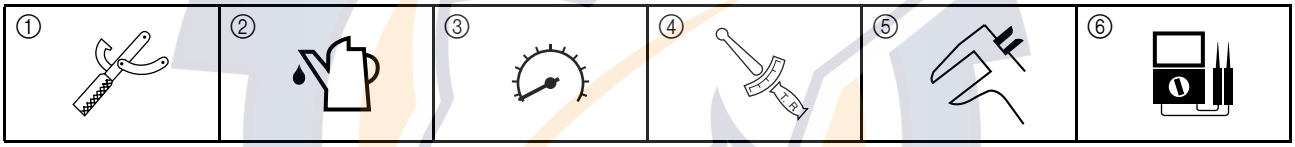
Periodic checks and adjustments



Lower unit

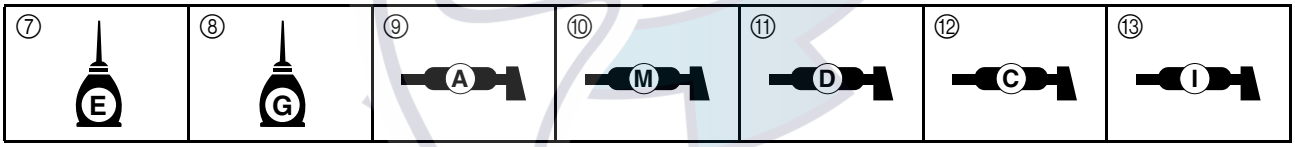
Troubleshooting

Symbols ① to ⑥ indicate specific data.



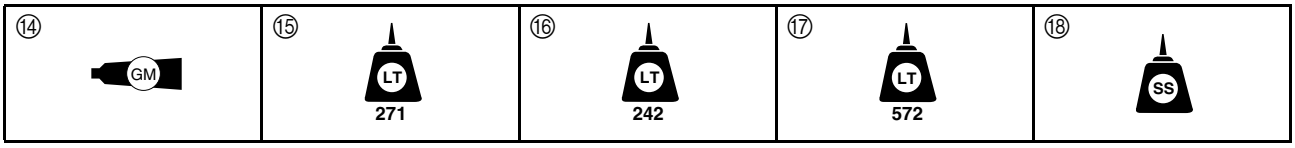
① Special tool
② Specified oil or fluid
③ Specified engine speed
④ Specified tightening torque
⑤ Specified measurement
⑥ Specified electrical value (resistance, voltage, electric current)

Symbols ⑦ to ⑬ in an exploded diagram indicate the grade of lubricant and the lubrication point.



⑦ Apply Yamaha 4-stroke motor oil
⑧ Apply gear oil
⑨ Apply water resistant grease (Yamaha grease A)
⑩ Apply molybdenum disulfide grease
⑪ Apply corrosion resistant grease (Yamaha grease D)
⑫ Apply low temperature resistant grease (Yamaha grease C)
⑬ Apply injector grease

Symbols ⑭ to ⑱ in an exploded diagram indicate the type of sealant or locking agent and the application point.



⑭ Apply Gasket Maker
⑮ Apply LOCTITE 271 (red)
⑯ Apply LOCTITE 242 (blue)
⑰ Apply LOCTITE 572
⑱ Apply silicon sealant

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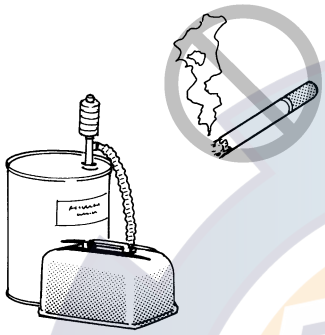
Safety while working

To prevent an accident or injury and to ensure quality service, follow the safety procedures provided below.

Fire prevention

Gasoline is highly flammable.
Keep gasoline and all flammable products away from heat, sparks, and open flames.



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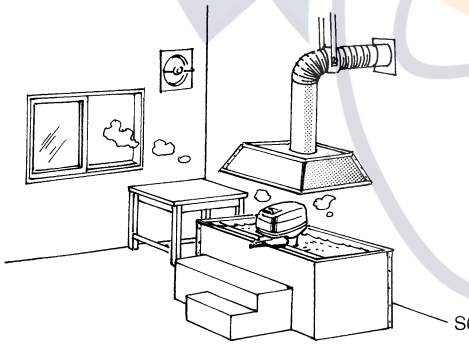
Ventilation

Gasoline vapor and exhaust gas are heavier than air and extremely poisonous. If inhaled in large quantities they may cause loss of consciousness and death within a short time.
When test running an engine indoors (e.g., in a water tank) be sure to do so where adequate ventilation can be maintained.



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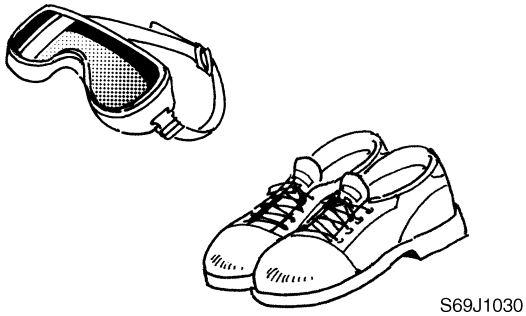
Self-protection

Protect your eyes by wearing safety glasses or safety goggles during all operations involving drilling and grinding, or when using an air compressor.
Protect your hands and feet by wearing protective gloves and safety shoes when necessary.



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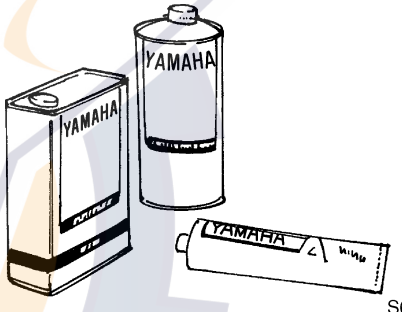
Parts, lubricants, and sealants

Use only genuine Yamaha parts, lubricants, and sealants or those recommended by Yamaha, when servicing or repairing the outboard motor.



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Under normal conditions, the lubricants mentioned in this manual should not harm or be hazardous to your skin. However, you should follow these precautions to minimize any risk when working with lubricants.

1. Maintain good standards of personal and industrial hygiene.
2. Change and wash clothing as soon as possible if soiled with lubricants.
3. Avoid contact with skin. Do not, for example, place a soiled rag in your pocket.
4. Wash hands and any other part of the body thoroughly with soap and hot water after contact with a lubricant or lubricant soiled clothing has been made.
5. To protect your skin, apply a protective cream to your hands before working on the outboard motor.

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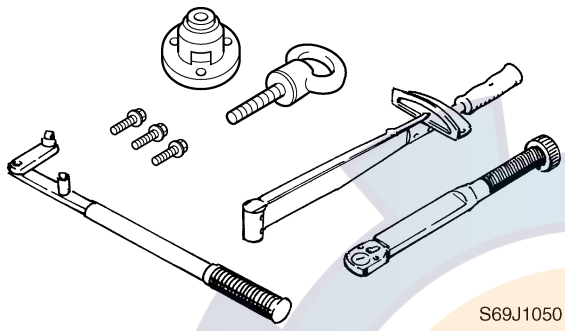
6. Keep a supply of clean, lint-free cloths for wiping up spills, etc.

Good working practices

Special service tools

Use the recommended special service tools to protect parts from damage. Use the right tool in the right manner—do not improvise.



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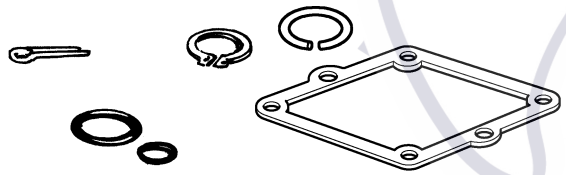
Tightening torques

Follow the tightening torque specifications provided throughout the manual. When tightening nuts, bolts, and screws, tighten the large sizes first, and tighten fasteners starting in the center and moving outward.

Non-reusable parts

Always use new gaskets, seals, O-rings, cotter pins, circlips, etc., when installing or assembling parts.



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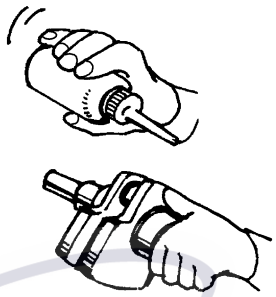
Disassembly and assembly

1. Use compressed air to remove dust and dirt during disassembly.

2. Apply engine oil to the contact surfaces of moving parts before assembly.



S69J1070

3. Install bearings with the manufacture identification mark in the direction indicated in the installation procedure. In addition, be sure to lubricate the bearings liberally.

4. Apply a thin coat of water-resistant grease to the lip and periphery of an oil seal before installation.

5. Check that moving parts operate normally after assembly.

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Identification

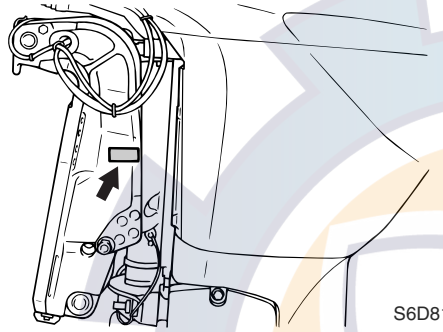
Applicable model

This manual covers the following model.

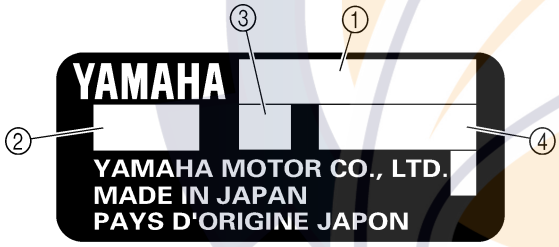
Applicable model
F90TR

Serial number

The outboard motor serial number is stamped on a label attached to the port clamp bracket.



S6D81010



S69J1090N

① Model name
② Approved model code
③ Transom height
④ Serial number

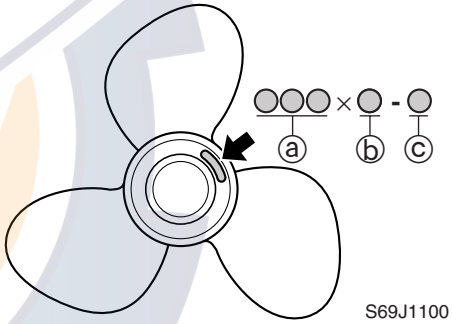
Model name	Approved model code	Starting serial No.
F90TR	61P	1007790–

Propeller selection

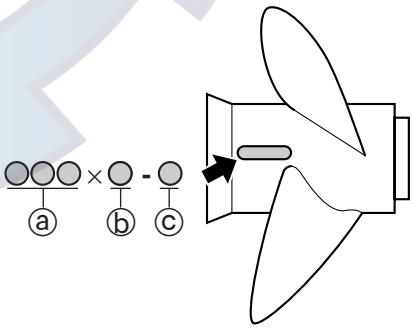
The performance of a boat and outboard motor will be critically affected by the size and type of propeller you choose. Propellers greatly affect boat speed, acceleration, engine life, fuel economy, and even boating and steering capabilities. An incorrect choice could adversely affect performance and could also seriously damage the engine.
Use the following information as a guide for selecting a propeller that meets the operating conditions of the boat and the outboard motor.

Propeller size

The size of the propeller is indicated on the propeller boss end, on the side of the propeller boss.



S69J1100



S60C1120

ⓐ Propeller diameter (in inches)
ⓑ Propeller pitch (in inches)
ⓒ Propeller type (propeller mark)

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Selection

When the engine speed is at the full throttle operating range (5,000–6,000 r/min), the ideal propeller for the boat is one that provides maximum performance in relation to boat speed and fuel consumption.

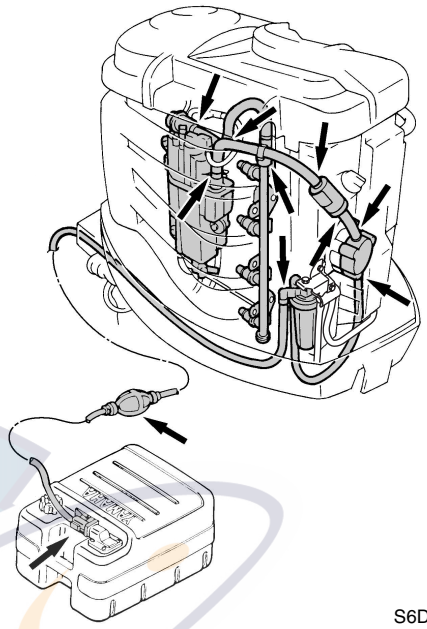
Propeller size (in)	Material
12 5/8 × 21 - K	Aluminum
13 × 19 - K	
13 × 23 - K	
13 × 25 - K	
13 1/4 × 17 - K	
13 1/2 × 15 - K	
13 5/8 × 13 - K	
14 × 11 - K	
13 × 17 - K	Stainless
13 × 19 - K	
13 × 21 - K	
13 × 23 - K	
13 × 25 - K	
13 1/2 × 14 - K	
13 1/2 × 16 - K	

Predelivery checks

To make the delivery process smooth and efficient, the predelivery checks should be completed as explained below.

Checking the fuel system

1. Check that the fuel hoses are securely connected and that the fuel tank is full with fuel.



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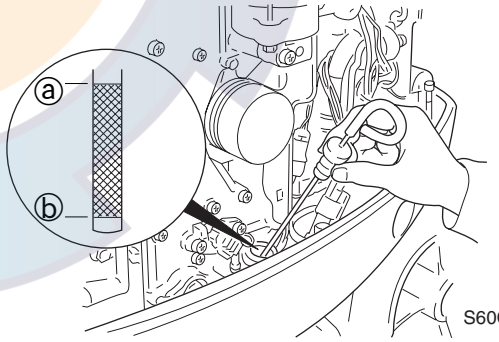
CAUTION:

This is a 4-stroke engine. Never use premixed fuel.

Checking the engine oil level

1. Check the engine oil level.



S60C1150

NOTE:

If the engine oil is below the minimum level mark ⓑ, add sufficient oil until the level is between ⓐ and ⓑ.

Recommended engine oil:
4-stroke motor oil
API: SE, SF, SG, SH, or SJ
SAE: 10W-30 or 10W-40
Engine oil quantity:
Without oil filter replacement:
4.3 L (4.55 US qt, 3.78 Imp qt)

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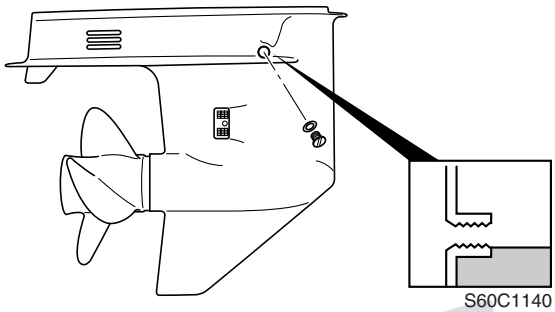
Checking the gear oil level

1. Check the gear oil level.


S60C1140

Checking the battery

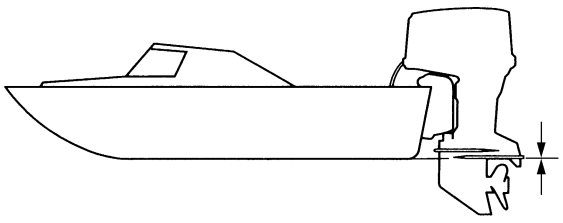
1. Check the capacity, electrolyte level, and specified gravity of the battery.

Recommended battery capacity:
CCA/SAE: 380 A
MCA/ABYC: 502 A
RC/SAE: 124 Minute
Electrolyte specified gravity:
1.280 at 20 °C (68 °F)

2. Check that the positive and negative battery leads are securely connected.

Checking the outboard motor mounting height

1. Check that the anti-cavitation plate is aligned with the bottom of the boat. If the mounting height is too high, cavitation will occur and propulsion will be reduced. Also, the engine speed will increase abnormally and cause the engine to overheat. If the mounting height is too low, water resistance will increase and reduce engine efficiency.

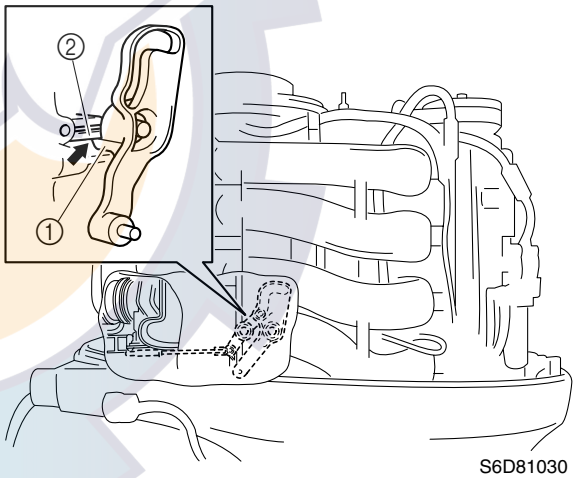

S69J1160

NOTE:
The optimum mounting height is affected by the combination of the boat and the outboard motor. To determine the optimum mounting height, test run the outboard motor at different heights.

2. Check that the clamp brackets are secured with the clamp bolts.

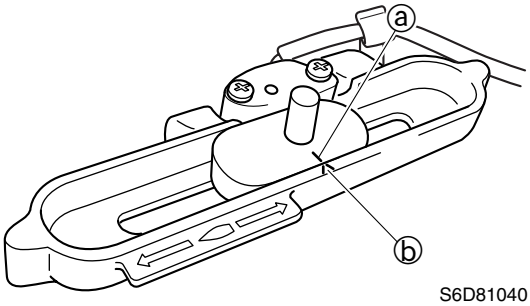
Checking the remote control cables

1. Set the remote control lever to the neutral position and fully close the throttle lever.
2. Check that the stopper ① on the throttle cam contacts the fully closed stopper ② on the cylinder block.



S6D81030

3. Check that the alignment mark ⓐ on the bushing is aligned with the alignment mark ⓑ on the bracket.



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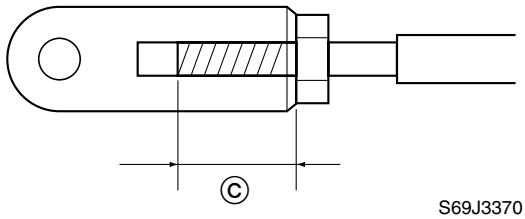

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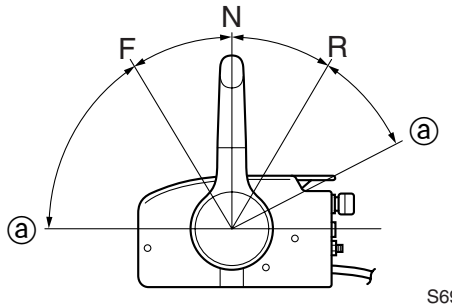


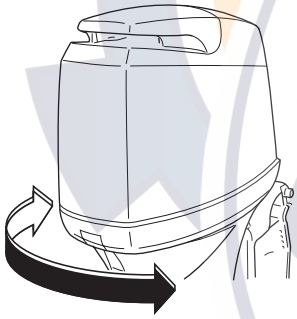
S69J1210

⚠ WARNING

The shift/throttle cable joint must be screwed in a minimum of 8.0 mm (0.31 in) ⓒ.

Checking the steering system

1. Check the steering friction for proper adjustment.
2. Check that the steering operates smoothly.


S60C1200

3. Check that there is no interference with wires or hoses when the outboard motor is steered.

Checking the gear shift and throttle operation

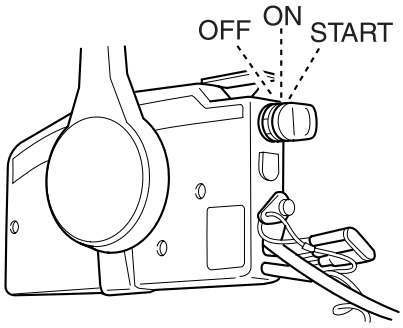
1. Check that the gear shift operates smoothly when the remote control lever is shifted from neutral to forward or reverse.
2. Check that the throttle operates smoothly when the remote control lever is shifted from forward or reverse to the fully open position ⓐ.

Checking the power trim and tilt system

1. Check that the outboard motor tilts up and down smoothly when operating the power trim and tilt unit.
2. Check that there is no abnormal noise produced when the outboard motor is tilted up or down.
3. Check that there is no interference with wires or hoses when the tilted-up outboard motor is steered.
4. Check that the trim meter points down when the outboard motor is tilted all the way down.

Checking the engine start switch and engine stop lanyard switch

1. Check that the engine starts when the engine start switch is turned to START.
2. Check that the engine turns off when the engine start switch is turned to OFF.



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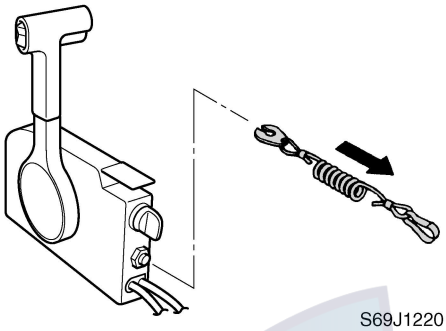
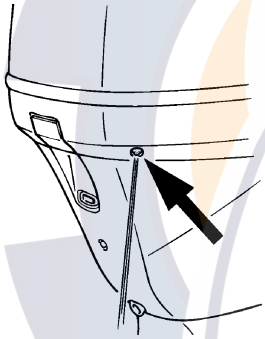
3. Check that the engine turns off when the engine stop lanyard is pulled from the engine stop lanyard switch.



S69J1220

Checking the cooling water pilot hole

1. Check that cooling water is discharged from the cooling water pilot hole.



S63P3120

Test run

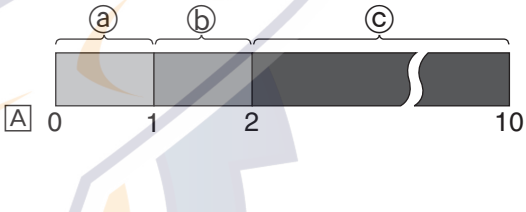
1. Start the engine, and then check that the gear shift operates smoothly.
2. Check the engine idle speed after the engine has been warmed up.
3. Operate at trolling speed.
4. Run the outboard motor for 1 hour at 2,000 r/min or at half throttle, then for another hour at 3,000 r/min or at 3/4 throttle.
5. Check that the outboard motor does not tilt up when shifting into reverse and that water does not flow in over the transom.

NOTE:
The test run is part of the break-in operation.

Break-in

During the test run, perform the break-in operation in the following three stages.

1. One hour ⓐ at 2,000 r/min or at approximately half throttle
2. One hour ⓑ at 3,000 r/min or 3/4 throttle and 1 minute out of every 10 at full throttle
3. Eight hours ⓒ at any speed, however, avoid running at full speed for more than 5 minutes



S69J1240

A Hour

After test run

1. Check for water in the gear oil.
2. Check for fuel leakage in the cowling.
3. Flush the cooling water passage with fresh water using the flushing kit and with the engine running at idle.

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Specifications

General specifications **2-1**

Maintenance specification **2-3**
Power unit 2-3
Lower unit 2-6
Electrical 2-6
Dimensions 2-9

Tightening torques **2-11**
Specified torques 2-11
General torques 2-13

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General specifications

Item	Unit	Model
		F90TR
Dimension		
Overall length	mm (in)	817 (32.2)
Overall width	mm (in)	479 (18.9)
Overall height		
(L)	mm (in)	1,582 (62.3)
(X)	mm (in)	1,710 (67.3)
Boat transom height		
(L)	mm (in)	508 (20.0)
(X)	mm (in)	635 (25.0)
Weight		
(without propeller)		
(L)	kg (lb)	168 (370)
(X)	kg (lb)	172 (379)
Performance		
Maximum output	kW (hp)	66.2 (90) at 5,500 r/min
Full throttle operating range	r/min	5,000–6,000
Maximum fuel consumption	L (US gal, Imp gal)/hr	33.0 (8.72, 7.26) at 6,000 r/min
Engine idle speed	r/min	700 ± 50
Power unit		
Type		In-line, 4-stroke, DOHC, 16 valves
Cylinder quantity		4
Total displacement	cm^3 (cu. in)	1,596 (97.39)
Bore × stroke	mm (in)	79.0 × 81.4 (3.11 × 3.20)
Compression ratio		9.6
Control system		Remote control
Starting system		Electric
Fuel system		Fuel injection
Ignition control system		TCI
Advance type		Micro computer
Maximum generator output	V, A	12, 25
Spark plug		LFR5A-11 (NGK)
Cooling system		Water
Exhaust system		Propeller boss
Lubrication system		Wet sump

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Item	Unit	Model
		F90TR
Fuel and oil		
Fuel type		Regular unleaded gasoline
Fuel minimum rating	RON(*1)	91
	PON	86
Engine oil		4-stroke motor oil
Engine oil grade	API	SE, SF, SG, SH, or SJ
	SAE	10W-30 or 10W-40
Engine oil quantity		
(without oil filter replacement)	L (US qt, Imp qt)	4.3 (4.55, 3.78)
(with oil filter replacement)	L (US qt, Imp qt)	4.5 (4.76, 3.96)
Gear oil type		GEAR CASE LUBE
Gear oil grade	SAE	90
Gear oil quantity	cm^3 (US oz, Imp oz)	670 (22.7, 23.6)
Bracket unit		
Trim angle (at 12° boat transom)	Degree	–4 to 16
Tilt-up angle	Degree	70
Steering angle	Degree	35 + 35
Drive unit		
Gear shift positions		F-N-R
Gear ratio		2.31 (30/13)
Reduction gear type		Spiral bevel gear
Clutch type		Dog clutch
Propeller shaft type		Spline
Propeller direction (rear view)		Clockwise
Propeller mark		K
Electrical		
Battery minimum capacity(*2)		
CCA/SAE	A	380
MCA/ABYC	A	502
RC/SAE	Minute	124

(*1) RON: Research Octane Number
PON: Pump Octane Number =
(RON + Motor Octane Number)/2

(*2) CCA: Cold Cranking Ampere
MCA: Marine Cranking Ampere
ABYC: American Boat and Yacht Council
SAE: Society of Automotive Engineers
RC: Reserve Capacity

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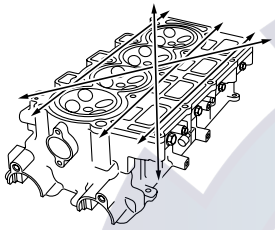
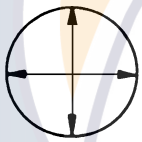
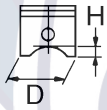
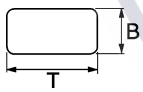
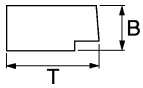
Maintenance specification

Power unit

Item	Unit	Model
		F90TR
Power unit		
Minimum compression pressure(*1)	kPa (kgf/cm^2, psi)	860 (8.6, 124.7)
Oil pressure(*2)	kPa (kgf/cm^2, psi)	510 (5.1, 74.0) at engine idle speed
Cylinder head		
Warpage limit	mm (in)	0.1 (0.0039)
 (lines indicate straightedge position)		
Camshaft cap inside diameter	mm (in)	25.000–25.021 (0.9843–0.9851)
Cylinders		
Bore size 	mm (in)	79.000–79.020 (3.1102–3.1110)
Taper limit	mm (in)	0.08 (0.0032)
Out-of-round limit	mm (in)	0.05 (0.0020)
Pistons		
Piston diameter (D) 	mm (in)	78.928–78.949 (3.1074–3.1082)
Measuring point (H)	mm (in)	13.0 (0.51)
Piston clearance	mm (in)	0.070–0.080 (0.0028–0.0031)
Over size piston diameter	mm (in)	79.178–79.199 (3.1172–3.1181)
Piston rings		
Top ring		
Dimension B 	mm (in)	1.17–1.19 (0.0461–0.0469)
Dimension T	mm (in)	2.80–3.00 (0.1102–0.1181)
End gap	mm (in)	0.15–0.30 (0.0059–0.0118)
Side clearance	mm (in)	0.04–0.08 (0.0016–0.0031)
2nd piston ring		
Dimension B 	mm (in)	1.47–1.49 (0.0579–0.0587)
Dimension T	mm (in)	3.00–3.20 (0.1181–0.1260)
End gap	mm (in)	0.70–0.90 (0.0276–0.0354)
Side clearance	mm (in)	0.03–0.07 (0.0012–0.0028)

(*1) Measuring conditions:
Ambient temperature 20 °C (68 °F), wide open throttle, with spark plugs removed from all cylinders.
The figures are for reference only.

(*2) The figures are for reference only.

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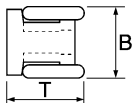
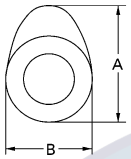
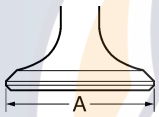
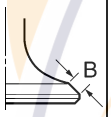
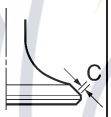
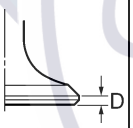
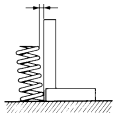
Item	Unit	Model
		F90TR
Oil ring		
Dimension B 	mm (in)	2.38–2.48 (0.0937–0.0976)
Dimension T(*)	mm (in)	2.40 (0.0945)
End gap	mm (in)	0.20–0.70 (0.0079–0.0276)
Side clearance	mm (in)	0.03–0.15 (0.0012–0.0059)
Camshafts		
Intake (A) 	mm (in)	36.48–36.58 (1.4362–1.4402)
Exhaust (A)	mm (in)	36.90–37.06 (1.4528–1.4591)
Intake (B)	mm (in)	29.95–30.05 (1.1791–1.1831)
Exhaust (B)	mm (in)	29.92–30.08 (1.1780–1.1842)
Camshaft journal diameter	mm (in)	24.960–24.980 (0.9827–0.9835)
Camshaft runout limit	mm (in)	0.03 (0.0012)
Valves		
Valve clearance (cold)		
Intake	mm (in)	0.20 ± 0.03 (0.008 ± 0.001)
Exhaust	mm (in)	0.34 ± 0.03 (0.013 ± 0.001)
Head diameter (A) 		
Intake	mm (in)	29.0–29.2 (1.14–1.15)
Exhaust	mm (in)	24.0–24.2 (0.94–0.95)
Face width (B) 		
Intake	mm (in)	1.99–2.44 (0.0783–0.0961)
Exhaust	mm (in)	2.27–2.72 (0.0894–0.1071)
Seat contact width (C) 		
Intake	mm (in)	1.20–1.60 (0.0472–0.0630)
Exhaust	mm (in)	1.20–1.60 (0.0472–0.0630)
Margin thickness (D) 		
Intake	mm (in)	0.80–1.20 (0.0315–0.0472)
Exhaust	mm (in)	1.00–1.40 (0.0394–0.0551)
Stem diameter		
Intake	mm (in)	5.975–5.990 (0.2352–0.2358)
Exhaust	mm (in)	5.960–5.975 (0.2346–0.2352)
Guide inside diameter		
Intake and exhaust	mm (in)	6.000–6.018 (0.2362–0.2369)
Stem-to-guide clearance		
Intake	mm (in)	0.010–0.043 (0.0004–0.0017)
Exhaust	mm (in)	0.025–0.058 (0.0010–0.0023)
Stem runout limit	mm (in)	0.01 (0.0004)
Valve springs		
Free length 	mm (in)	53.20 (2.0945)
Tilt limit	mm (in)	2.6 (0.10)

(*) The figure is for reference only.

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Item	Unit	Model
		F90TR
Valve lifters		
Valve lifter outside diameter	mm (in)	27.965–27.980 (1.1010–1.1016)
Valve lifter-to-cylinder head clearance	mm (in)	0.020–0.056 (0.0008–0.0022)
Valve shims		
Valve shim thickness (in 0.025 mm increments)	mm (in)	2.0–3.3 (0.08–0.13)
Connecting rods		
Big end inside diameter	mm (in)	47.025–47.045 (1.8514–1.8522)
Big end side clearance	mm (in)	0.14–0.28 (0.0055–0.0110)
Crankpin oil clearance	mm (in)	0.024–0.044 (0.0009–0.0017)
Big-end bearing thickness		
Yellow	mm (in)	1.499–1.506 (0.0590–0.0593)
Green	mm (in)	1.506–1.513 (0.0593–0.0596)
Blue	mm (in)	1.513–1.520 (0.0596–0.0598)
Red	mm (in)	1.520–1.527 (0.0598–0.0601)
Crankshaft		
Crankshaft journal diameter	mm (in)	47.985–48.000 (1.8892–1.8898)
Crankpin diameter	mm (in)	43.982–44.000 (1.7316–1.7323)
Crankpin width	mm (in)	21.00–21.07 (0.8268–0.8295)
Runout limit	mm (in)	0.03 (0.0012)
Crankcase		
Crankshaft journal oil clearance	mm (in)	0.024–0.044 (0.0009–0.0017)
Upper crankcase main bearing thickness		
Green	mm (in)	2.992–2.999 (0.1178–0.1181)
Blue	mm (in)	2.999–3.006 (0.1181–0.1183)
Red	mm (in)	3.006–3.013 (0.1183–0.1186)
Upper crankcase main bearing #3 thickness		
Green	mm (in)	2.992–2.999 (0.1178–0.1181)
Blue	mm (in)	2.999–3.006 (0.1181–0.1183)
Red	mm (in)	3.006–3.013 (0.1183–0.1186)
Lower crankcase main bearing thickness		
Yellow	mm (in)	3.010–3.017 (0.1185–0.1188)
Green	mm (in)	3.017–3.024 (0.1188–0.1191)
Blue	mm (in)	3.024–3.031 (0.1191–0.1193)
Red	mm (in)	3.031–3.038 (0.1193–0.1196)

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Item	Unit	Model
		F90TR
Oil pump		
Discharge at 97–103 °C (207–217 °F) with 10W-30 engine oil	L (US gal, Imp gal)/min	5.9 (1.559, 1.298) at 1,000 r/min
Pressure at 97–103 °C (207–217 °F) with 10W-30 engine oil	kPa (kgf/cm^2, psi)	118.0 (1.18, 17.1) at 1,000 r/min
Relief valve opening pressure	kPa (kgf/cm^2, psi)	441–539 (4.41–5.39, 63.9–78.2)
Thermostat		
Opening temperature	°C (°F)	58–62 (136–144)
Fully open temperature	°C (°F)	70 (158)
Valve open lower limit	mm (in)	4.3 (0.17)

Lower unit

Item	Unit	Model
		F90TR
Gear backlash		
Pinion-to-forward gear	mm (in)	0.28–0.63 (0.0110–0.0248)
Pinion shims	mm	0.10, 0.12, 0.15, 0.18, 0.30, 0.40, 0.50
Forward gear shims	mm	0.10, 0.12, 0.15, 0.18, 0.30, 0.40, 0.50

Electrical

Item	Unit	Model
		F90TR
Ignition and ignition control system		
Spark plug gap	mm (in)	1.0–1.1 (0.039–0.043)
Ignition coil resistance at 20 °C (68 °F)		
Primary coil (R – B/W)	Ω	1.53–2.07
Secondary coil	kΩ	12.495–16.905
Spark plug wire resistance		
#1	kΩ	4.5–10.7
#2	kΩ	3.3–8.0
#3	kΩ	3.7–8.9
#4	kΩ	4.3–10.2

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Specifications

Item	Unit	Model
		F90TR
ECM output peak voltage (B/R, B/W – Ground)		
at cranking (loaded)	V	210
at 1,500 r/min (loaded)	V	290
at 3,500 r/min (loaded)	V	290
Pulser coil output peak voltage (W/R, W/B – B)		
at cranking (unloaded)	V	3.6
at cranking (loaded)	V	3.4
at 1,500 r/min (loaded)	V	18.2
at 3,500 r/min (loaded)	V	34.3
Pulser coil resistance(*) (W/R, W/B – B)	Ω	459–561
Throttle position sensor		
Output voltage (P – B)	V	0.8–1.2 at engine idle speed
Cooling water temperature sensor resistance		
at 0 °C (32 °F)	kΩ	5.21–6.37
at 80 °C (176 °F)	kΩ	0.290–0.354
Oil pressure switch		
Operating pressure	kPa (kgf/cm^2, psi)	127.5–166.7 (1.28–1.67, 18.49–24.17)
Fuel control system		
Fuel injector resistance(*)		
at 21 °C (70 °F)	Ω	12.0
Starter motor		
Type		Sliding gear
Output	kW	1.40
Cranking time limit	Second	30
Brushes		
Standard length	mm (in)	15.5 (0.61)
Wear limit	mm (in)	9.5 (0.37)
Commutator		
Standard diameter	mm (in)	29.0 (1.14)
Wear limit	mm (in)	28.0 (1.10)
Mica		
Standard undercut	mm (in)	0.8 (0.03)
Wear limit	mm (in)	0.2 (0.01)

(*) The figures are for reference only.

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Item	Unit	Model
		F90TR
Charging system		
Fuse	A	20
Stator coil output peak voltage (W – W)		
at cranking (unloaded)	V	12.4
at 1,500 r/min (unloaded)	V	45.3
at 3,500 r/min (unloaded)	V	98.3
Stator coil resistance(*) (W – W)		
at 20 °C (68 °F)	Ω	0.24–0.36
Rectifier Regulator output peak voltage (R–Ground)		
at 1,500 r/min (unloaded)	V	13.0
at 3,500 r/min (unloaded)	V	13.0
Power trim and tilt system		
Trim sensor		
Setting resistance (P – B)	Ω	10 ± 1
Resistance (P – B)	Ω	9–378.8
Fluid type		ATF Dexron II
Brushes		
Standard length	mm (in)	10.0 (0.39)
Wear limit	mm (in)	3.5 (0.14)
Commutator		
Standard diameter	mm (in)	22.0 (0.87)
Wear limit	mm (in)	21.0 (0.83)
Mica		
Standard undercut	mm (in)	1.5 (0.06)
Wear limit	mm (in)	1.0 (0.04)

(*) The figure is for reference only.

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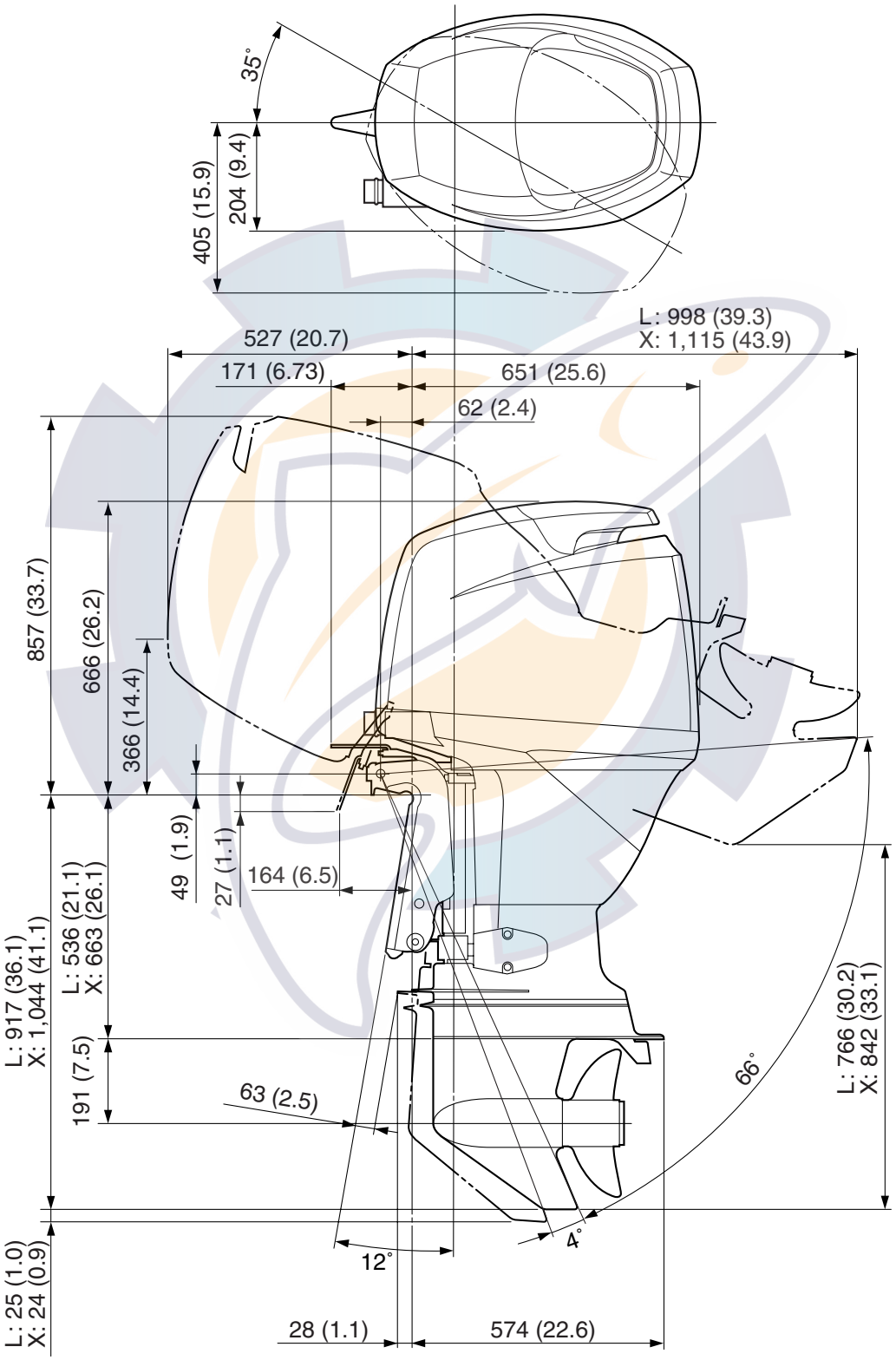
Dimensions

Exterior

mm (in)



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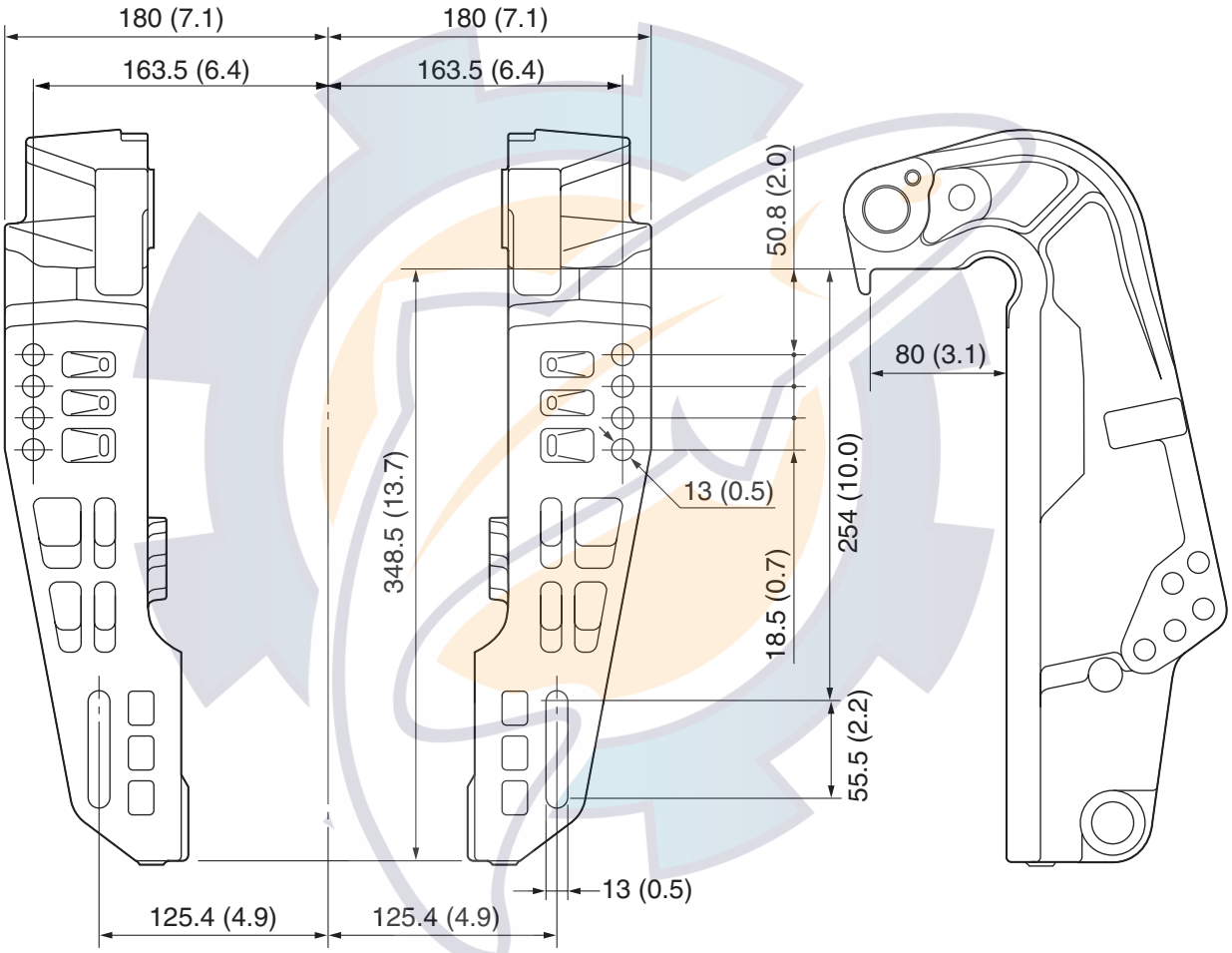
Clamp bracket

mm (in)



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Tightening torques

Specified torques

Part to be tightened		Thread size	Tightening torques		
			N·m	kgf·m	ft·lb
Fuel system					
Fuel filter cup		—	3	0.3	2.2
Fuel pump mounting bolt		M6	10	1.0	7.4
Fuel pump screw		M6	4	0.4	3.0
Sensor assembly screw		M5	3.7	0.37	2.7
Idle speed control screw		M5	3.7	0.37	2.7
Fuel rail mounting bolt		M6	8	0.8	5.9
Throttle body mounting bolt		M6	8	0.8	5.9
Fuel cooler screw		M6	3	0.3	2.2
Float chamber screw		M5	3	0.3	2.2
Vapor separator drain screw		—	1.5	0.15	1.1
Pressure regulator bolt		M6	5	0.5	3.7
Fuel hose joint		—	4	0.4	3.0
Plate screw		M4	2	0.2	1.5
Wiring harness holder screw		M4	2	0.2	1.5
Pressure check valve		—	10	1.0	7.4
Power unit					
Power unit mounting bolt	1st	M10	42	4.2	31.0
	2nd		42	4.2	31.0
Apron screw		M6	4	0.4	3.0
Flywheel magnet nut		M24	215	21.5	158.6
Starter motor bolt		M8	29	2.9	21.4
Spark plug wire cover screw		M6	4	0.4	3.0
Starter relay lead bolt		M6	4	0.4	3.0
Starter relay holder screw		M6	3	0.3	2.2
Main and fuel pump relay screw		M6	3	0.3	2.2
Oil pressure switch		—	8	0.8	5.9
Oil pressure switch lead bolt		M4	2	0.2	1.5
PTT relay lead nut		M6	4	0.4	3.0
PTT motor lead bolt		M6	4	0.4	3.0
Positive battery lead nut		M8	9	0.9	6.6
Timing belt tensioner bolt		M10	39	3.9	28.8
Drive sprocket nut		M40	265	26.5	195.5
Driven sprocket bolt		M10	60	6.0	44.3
Camshaft cap bolt	1st	M7	8	0.8	5.9
	2nd		17	1.7	12.5
Cylinder head cover plate screw		M4	2	0.2	1.5
Cylinder head cover bolt	1st	M6	8	0.8	5.9
	2nd		8	0.8	5.9

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Part to be tightened		Thread size	Tightening torques		
			N·m	kgf·m	ft·lb
Cylinder head bolt	1st	M8	14	1.4	10.3
	2nd		28	2.8	20.7
	1st	M10	15	1.5	11.1
	2nd		30	3.0	22.1
	3rd		90°		
Spark plug		—	25	2.5	18.4
Cylinder block plug		M14	23	2.3	17.0
Oil filter joint		—	49	4.9	36.1
Oil filter		—	18	1.8	13.3
Exhaust cover bolt	1st	M6	6	0.6	4.4
	2nd		12	1.2	8.9
Anode screw		M4	2	0.2	1.5
Exhaust cover plug		M18	55	5.5	40.6
Crankcase bolt	1st	M8	14	1.4	10.3
	2nd		28	2.8	20.7
	1st	M10	19	1.9	14.0
	2nd		60°		
Connecting rod cap bolt	1st	M8	18	1.8	13.3
	2nd		80°		
Lower unit					
Gear oil drain screw		—	9	0.9	6.6
Gear oil check screw		—	9	0.9	6.6
Lower case mounting bolt (L-transom model)		M10	39	3.9	28.8
Lower case mounting nut (X-transom model)		—	39	3.9	28.8
Propeller nut		M16	34	3.4	25.1
Ring nut		—	103	10.3	76.0
Cooling water inlet cover screw		—	5	0.5	3.7
Pinion nut		M16	93	9.3	68.6
Bracket unit					
Shift rod detent bolt		—	18	1.8	13.3
Shift position switch screw		M4	1	0.1	0.7
Flushing hose adapter screw		M6	2	0.2	1.5
Oil pump bolt		M6	10	1.0	7.4
Upper mounting nut		—	51	5.1	37.6
Lower mounting nut		—	51	5.1	37.6
Grease nipple		—	3	0.3	2.2
Oil pump cover screw		M6	4	0.4	3.0
Oil seal housing screw		M6	4	0.4	3.0
Upper mount bolt		M8	28	2.8	20.7
Muffler assembly bolt		M8	20	2.0	14.8
Engine oil drain bolt		M14	27	2.7	20.0
Oil strainer bolt		M6	10	1.0	7.4
Oil pan bolt		M6	11	1.1	8.1
Exhaust manifold bolt		M6	11	1.1	8.1

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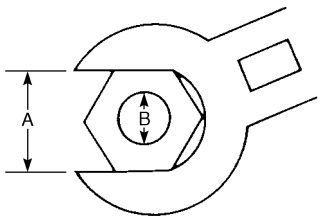
Part to be tightened	Thread size	Tightening torques		
		N·m	kgf·m	ft·lb
Steering arm stud bolt	M10	20	2.0	14.8
Self-locking nut	—	15	1.5	11.1
Trim sensor cam screw	M6	2	0.2	1.5
Power trim and tilt unit				
Reservoir cap	—	7	0.7	5.2
PTT motor bolt	M6	4	0.4	3.0
Gear pump bolt	M5	5	0.5	3.7
Gear pump housing bolt	M5	5	0.5	3.7
Relief valve cap bolt	M4	4	0.4	3.0
	M5	5	0.5	3.7
Lever bolt	M3	2	0.2	1.5
Manual valve	—	2	0.2	1.5
Gear pump bracket bolt	M3	2	0.2	1.5
	M5	4	0.4	3.0
Trim cylinder end screw	—	90	9.0	66.4
Tilt cylinder end screw	—	80	8.0	59.0
Tilt piston bolt	M12	85	8.5	62.7

General torques

This chart specifies tightening torques for standard fasteners with a standard ISO thread pitch. Tightening torque specifications for special components or assemblies are provided in applicable sections of this manual. To avoid warpage, tighten multi-fastener assemblies in a crisscross fashion and progressive stages until the specified torque is reached. Unless otherwise specified, torque specifications require clean, dry threads. Components should be at room temperature.

Nut (A)	Bolt (B)	General torque specifications		
		N·m	kgf·m	ft·lb
8 mm	M5	5	0.5	3.6
10 mm	M6	8	0.8	5.8
12 mm	M8	18	1.8	13
14 mm	M10	36	3.6	25
17 mm	M12	43	4.3	31



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Periodic checks and adjustments

Special service tools 3-1

Maintenance interval chart 3-2

Top cowling 3-3
Checking the top cowling 3-3

Fuel system 3-3
Checking the fuel joint and fuel hoses (fuel joint-to-fuel injector) 3-3
Checking the fuel filter 3-3

Power unit 3-4
Checking the engine oil 3-4
Changing the engine oil using an oil changer 3-4
Changing the engine oil by draining it 3-4
Replacing the oil filter 3-5
Checking the timing belt 3-6
Checking the spark plugs 3-6
Checking the thermostat 3-7
Checking the cooling water passage 3-8

Control system 3-8
Checking the engine idle speed 3-8
Adjusting the throttle link and throttle cable 3-8
Checking the gear shift operation 3-10

Bracket unit 3-11
Checking the power trim and tilt operation 3-11
Checking the power trim and tilt fluid level 3-11

Lower unit 3-12
Checking the gear oil level 3-12
Changing the gear oil 3-12
Checking the lower unit for air leakage 3-13
Checking the propeller 3-13

General 3-14
Checking the anodes 3-14
Checking the battery 3-14
Lubricating the outboard motor 3-15

3

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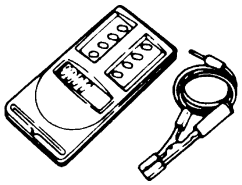
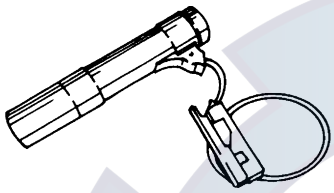
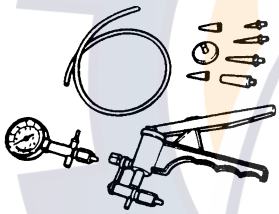
Special service tools



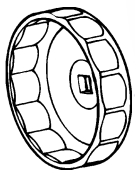
Digital tachometer
YU-39951-B



Battery powered timing light
YM-33277-A



Pressure/vacuum tester
YB-35956-A



Oil filter wrench
YU-38411

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Maintenance interval chart

Use the following chart as a guideline for general maintenance.
Adjust the maintenance intervals according to the operating conditions of the outboard motor.

Item	Remarks	Initial		Every		Refer to page
		10 hours (1 month)	50 hours (3 months)	100 hours (6 months)	200 hours (1 year)	
Anodes (external)	Check/replace		○	○		3-14
Anodes (internal)	Check/replace				○	3-14
Battery	Check/charge	○				3-14
Cooling water passages	Clean		○	○		3-8
Top cowling	Check				○	3-3
Fuel filter (can be disassembled)	Check/replace	○	○	○		3-3
Fuel system	Check	○	○	○		3-3
Gear oil	Change	○		○		3-12
Lubrication points	Lubricate			○		3-15
Engine idle speed (EFI models)	Check/adjust				○	3-8
PCV (Pressure Control Valve)	Check				○	5-38
Power trim and tilt unit	Check				○	3-11
Propeller and cotter pin	Check/replace		○	○		3-13
Shift link/shift cable	Check/adjust				○	3-10
Thermostat	Check				○	3-7
Throttle link/throttle cable/ throttle pick-up timing	Check/adjust				○	3-8
Water pump	Check				○	6-9
Engine oil	Check/change	○		○		3-4
Oil filter	Change				○	3-5
Spark plugs	Clean/adjust/ replace	○			○	3-6
Timing belt	Check/replace			○	○	3-6

NOTE:
When operating in salt water, turbid or muddy water, the engine should be flushed with clean water after each use.

Item	Remarks	Every		Refer to page
		500 hours (2.5 years)	1,000 hours (5 years)	
Timing belt	Replace		○	5-13
Valve clearance (DOHC)	Check/adjust	○		5-10

NOTE:
When using lead or high-sulfur gasoline, checking valve clearance may be required more frequently than every 500 hours.

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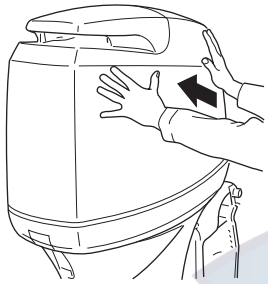
Top cowling

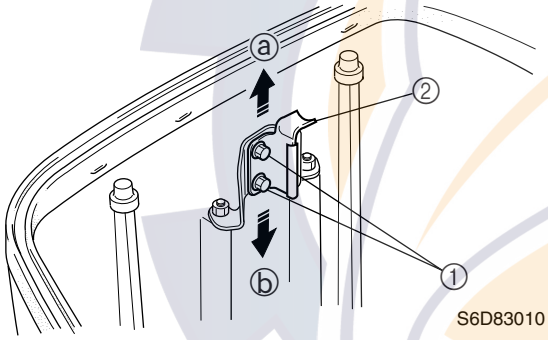
Checking the top cowling

1. Check the fitting by pushing the cowling with both hands. Adjust if necessary.



S60C3010

2. Loosen the bolts ①.
3. Move the hook ② up or down slightly to adjust its position.



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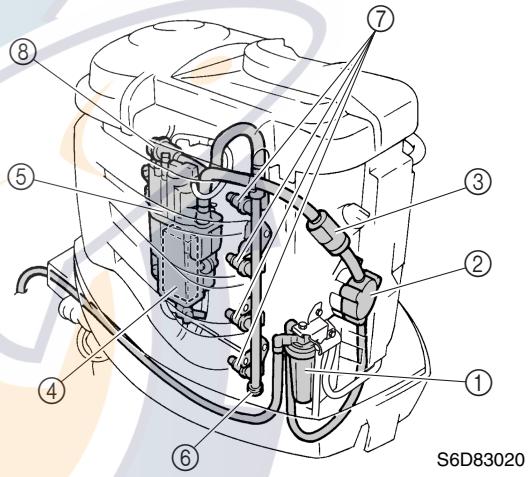
NOTE:
- To loosen the fitting, move the hook in direction ⓐ.
- To tighten the fitting, move the hook in direction ⓑ.

4. Tighten the bolts.
5. Check the fitting again and, if necessary, repeat steps 2–4.

Fuel system

Checking the fuel joint and fuel hoses (fuel joint-to-fuel injector)

1. Remove the flywheel magnet cover.
2. Check the low-pressure fuel hose connections and fuel joint for leaks. Replace if necessary. Also, check the fuel filter ①, fuel pump ②, strainer ③, and fuel cooler ④ for leaks or deterioration. Replace if necessary.
3. Check the high-pressure fuel hose connections for leaks. Replace if necessary. Also, check the vapor separator ⑤, fuel rail ⑥, fuel injectors ⑦, and pressure regulator ⑧ for leaks or deterioration. Replace if necessary.



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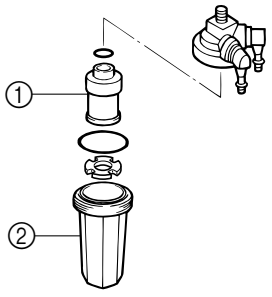
Checking the fuel filter

1. Check the fuel filter element ① for dirt and residue and check the fuel filter cup ② for foreign substances and cracks. Clean the cup with straight gasoline and replace the element if necessary.



S6D83030

NOTE:
Be sure not to spill any fuel when removing the fuel filter cup.

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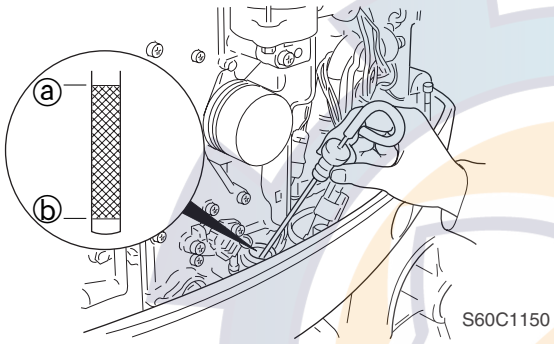
Power unit

Checking the engine oil

1. Place the outboard motor in an upright position.
2. Remove the oil dipstick, wipe it clean, and then insert it back into the dipstick hole.
3. Remove the oil dipstick again to check the oil level and to check the oil for discoloration and its viscosity.



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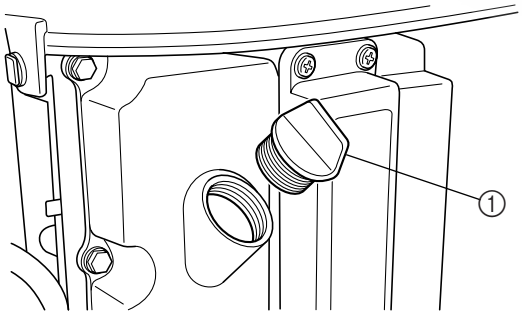
NOTE:
- Change the oil if it appears milky or dirty.
- If the engine oil is below the minimum level mark ⓑ, add sufficient oil until the level is between ⓐ and ⓑ.

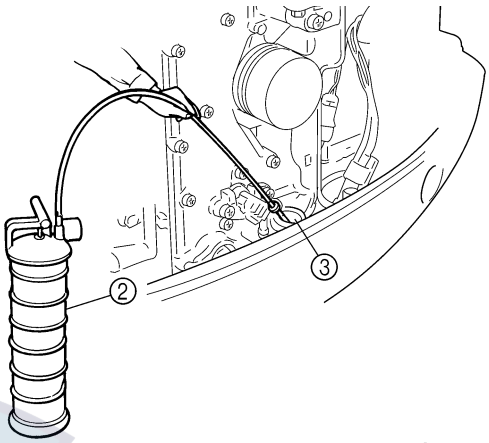
Changing the engine oil using an oil changer

1. Start the engine, warm it up, and then turn it off.
2. Remove the oil dipstick and oil filler cap ①.



S60C3060

3. Insert the tube of the oil changer ② into the dipstick hole ③.



S6D83040

4. Operate the oil changer to extract the oil.

NOTE:
Be sure to clean up any oil spills.

5. Pour the specified amount of the recommended engine oil into the oil filler hole.

Recommended engine oil:
4-stroke motor oil
API: SE, SF, SG, SH, or SJ
SAE: 10W-30 or 10W-40
Engine oil quantity:
Without oil filter replacement:
4.3 L (4.55 US qt, 3.78 Imp qt)

6. Install the oil filler cap and oil dipstick, and then start the engine and warm it up for 5 minutes.
7. Turn the engine off, and then check the oil level and correct it if necessary.

Changing the engine oil by draining it

1. Start the engine, warm it up, and then turn it off.

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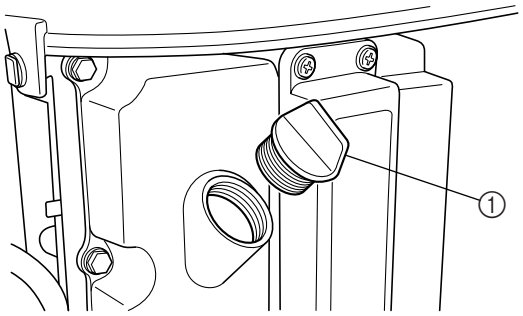
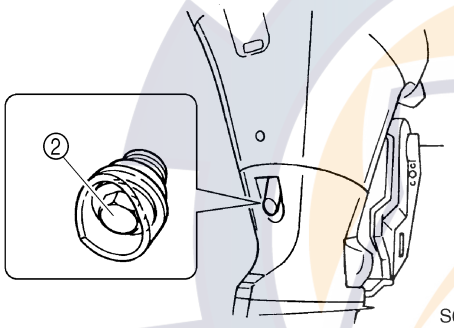
2. Remove the oil dipstick and oil filler cap ①.



S60C3060

3. Place a drain pan under the drain hole, and then remove the drain bolt ② and let the oil drain completely.



S63P3080

NOTE:
Be sure to clean up any oil spills.

4. Install the drain bolt, and then tighten it to the specified torque.

Engine oil drain bolt:
27 N·m (2.7 kgf·m, 20.0 ft·lb)

5. Pour the specified amount of the recommended engine oil into the oil filler hole.

Recommended engine oil:
4-stroke motor oil
API: SE, SF, SG, SH, or SJ
SAE: 10W-30 or 10W-40
Engine oil quantity:
Without oil filter replacement:
4.3 L (4.55 US qt, 3.78 Imp qt)

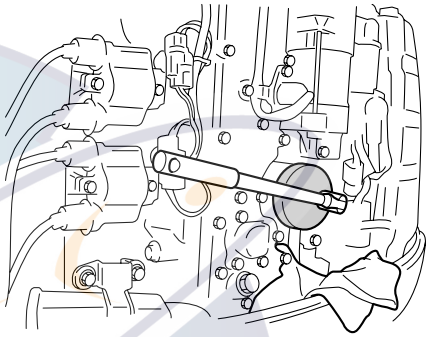
6. Install the oil filler cap and oil dipstick, and then start the engine and warm it up for 5 minutes.

7. Turn the engine off, and then check the oil level and correct it if necessary.

Replacing the oil filter

1. Extract the engine oil with an oil changer or drain it.

2. Place a rag under the oil filter, and then remove the oil filter using the oil filter wrench.


S6D83050

NOTE:
- Wait more than 5 minutes after turning the engine off to replace the oil filter.
- Be sure to clean up any oil spills.

Oil filter wrench: YU-38411

3. Apply a thin coat of engine oil to the O-ring of the new oil filter.

4. Install the oil filter, and then tighten it to the specified torque using the oil filter wrench.

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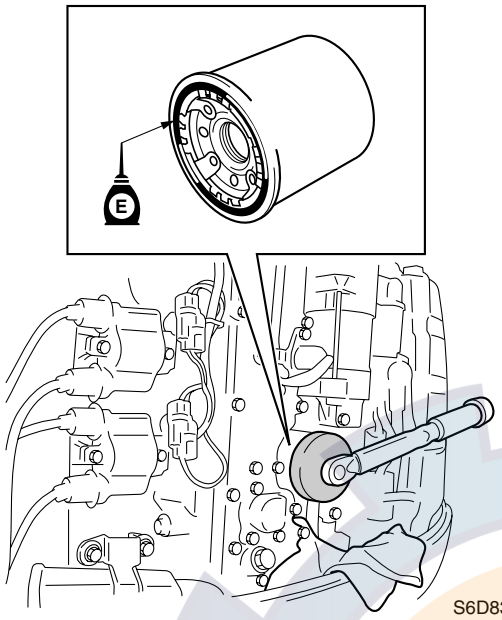

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Oil filter:
18 N·m (1.8 kgf·m, 13.3 ft·lb)

5. Pour the specified amount of the recommended engine oil into the oil filler hole.

Recommended engine oil:
4-stroke motor oil
API: SE, SF, SG, SH, or SJ
SAE: 10W-30 or 10W-40
Engine oil quantity:
With oil filter replacement:
4.5 L (4.76 US qt, 3.96 Imp qt)

6. Install the oil filler cap and oil dipstick, and then start the engine and warm it up for 5 minutes.

7. Turn the engine off, and then check the oil level and correct it if necessary.

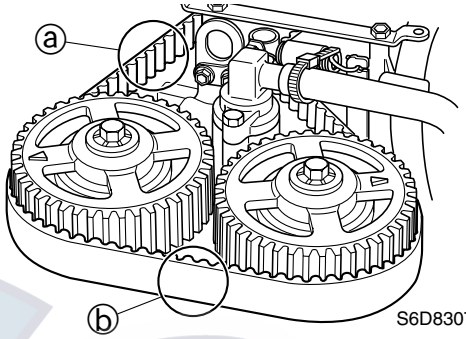
Checking the timing belt

CAUTION:

Do not turn the flywheel magnet counterclockwise, otherwise the valve system may be damaged.

1. Remove the flywheel magnet cover.

2. While turning the flywheel magnet clockwise, check the interior ⓐ and the exterior ⓑ of the timing belt for cracks, damage, or wear. Replace if necessary.



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NOTE:

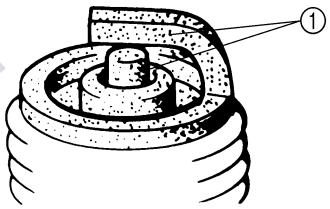
For replacement procedures, see Chapter 5, “Replacing the timing belt.”

Checking the spark plugs

1. Remove the spark plug wire cover.

2. Disconnect the spark plug wires, and then remove the spark plugs.

3. Clean the electrodes ① with a spark plug cleaner or wire brush. Replace the spark plug if necessary.



S69J3190

4. Check the electrodes for erosion and excessive carbon or other deposits, and the gasket for damage. Replace the spark plug if necessary.

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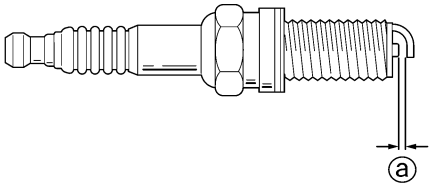
5. Check the spark plug gap ⓐ. Adjust if out of specification.



S69J3200

Specified spark plug:
LFR5A-11 (NGK)
Spark plug gap ⓐ:
1.0–1.1 mm (0.039–0.043 in)

6. Install the spark plugs, tighten them finger tight, then to the specified torque using a spark plug wrench.

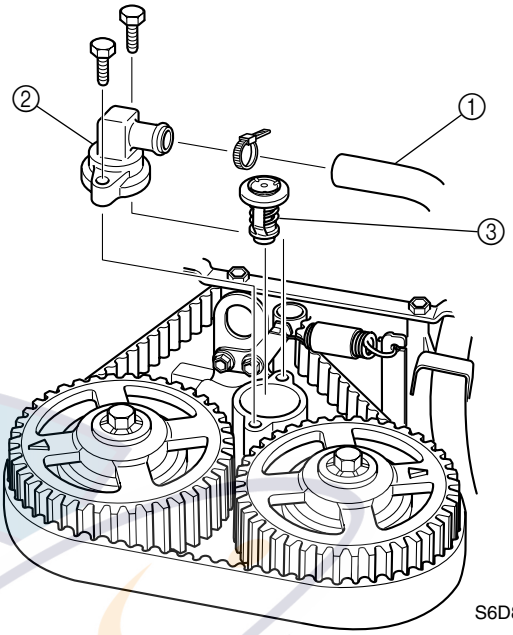
Spark plug:
25 N·m (2.5 kgf·m, 18.4 ft·lb)

7. Install the spark plug wire cover.

Spark plug wire cover screw:
4 N·m (0.4 kgf·m, 3.0 ft·lb)

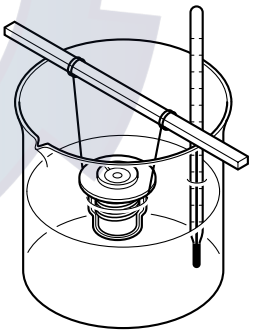
Checking the thermostat

1. Remove the flywheel magnet cover.
2. Disconnect the cooling water hose ①, and then remove the thermostat cover ② and thermostat ③.



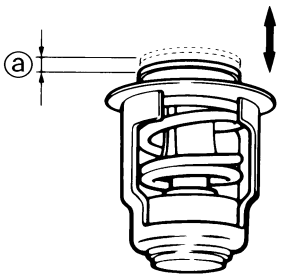
S6D83080

3. Suspend the thermostat in a container of water.
4. Place a thermometer in the water and slowly heat the water.



S69J5E40

5. Check the thermostat valve opening at the specified water temperatures. Replace if out of specification.



S69J5E50

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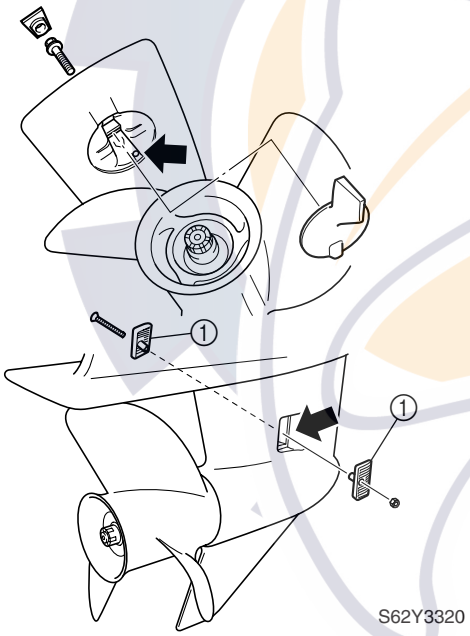
Water temperature	Valve lift ⓐ
58–62 °C (136–144 °F)	0.05 mm (0.0020 in) (valve begins to lift)
above 70 °C (158 °F)	more than 4.3 mm (0.17 in)

6. Install the thermostat and cover.

7. Connect the cooling water hose, and then install the flywheel magnet cover.

Checking the cooling water passage

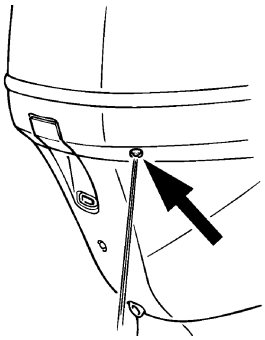
1. Check the cooling water inlet cover ① and cooling water inlet for clogs. Clean if necessary.



S62Y3320

2. Place the lower unit in water, and then start the engine.

3. Check for water flow at the cooling water pilot hole. If there is no water flow, check the cooling water passage inside the outboard motor.

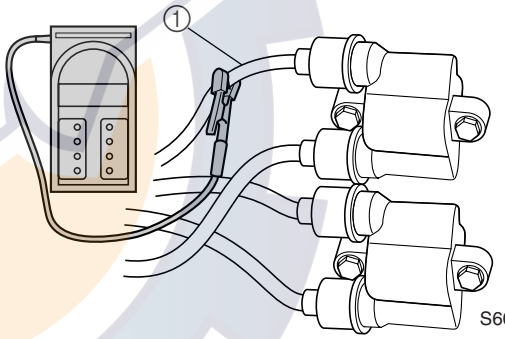

S63P3120

Control system

Checking the engine idle speed

1. Start the engine and warm it up for 5 minutes.

2. Attach the special service tool to spark plug wire #1 ①, and then check the engine idle speed.



S60C3450

Digital tachometer: YU-39951-B

Engine idle speed: 700 ± 50 r/min

Adjusting the throttle link and throttle cable

1. Remove the intake silencer.

2. Set the remote control lever to the neutral position and fully close the throttle lever.

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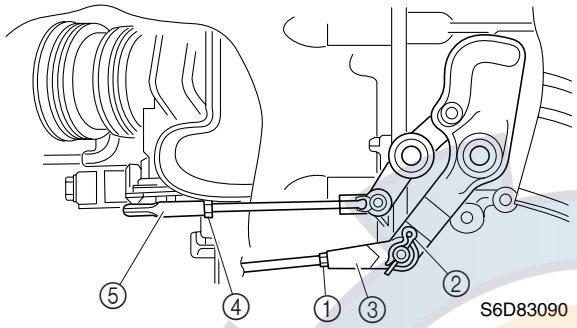
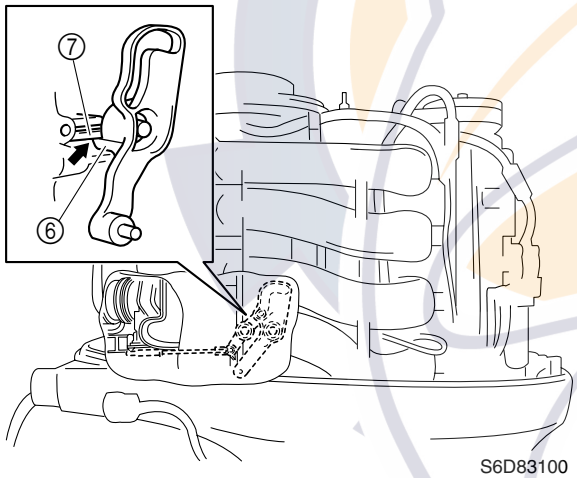
3. Loosen the locknut ①, remove the clip ②, and then disconnect the throttle cable joint ③.

4. Loosen the locknut ④, and then disconnect the throttle link rod joint ⑤ from the ball joint of the throttle body.



S6D83090

5. Check that the stopper ⑥ on the throttle cam contacts the fully closed stopper ⑦ on the cylinder block.

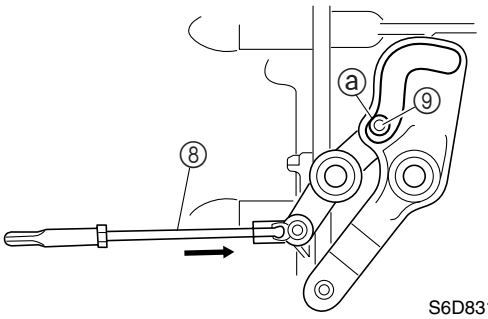


S6D83100

6. Check that the throttle valve fully close.

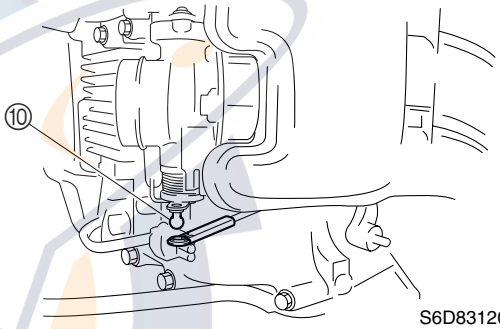
NOTE:
Do not turn the throttle stop screw.

7. Push the throttle link rod ⑧ toward the cylinder head and check that the throttle cam roller ⑨ contacts the side ⓐ of the throttle cam.



S6D83110

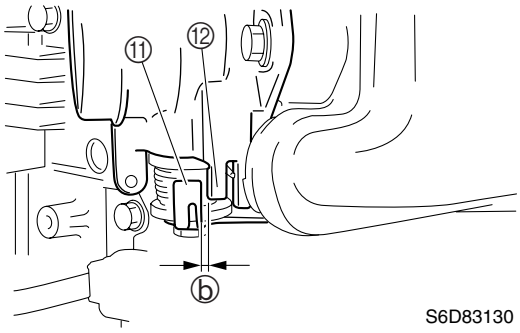
8. Adjust the throttle link rod joint to align its hole with the ball joint ⑩ on the throttle body.



S6D83120

9. Connect the throttle link rod joint, and then tighten the locknut.

10. Operate the throttle cam to check that the throttle valve fully closes and fully opens, and check that the gap ⓑ between the stopper ⑪ on the throttle lever and fully open stopper ⑫ on the throttle body is less than 5 mm (0.20 in) when the throttle cam is in the fully open position.



S6D83130

11. Adjust the position of the throttle cable joint until its hole is aligned with the set pin on the throttle cam.

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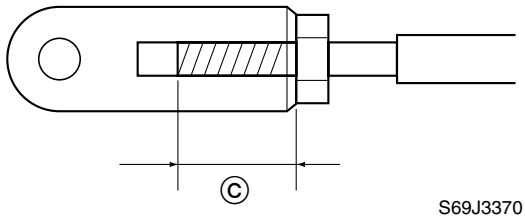


S69J3370

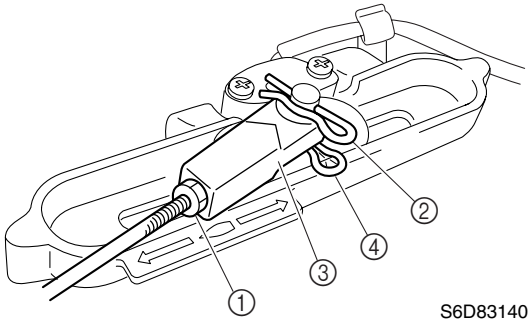
⚠ WARNING

The throttle cable joint must be screwed in a minimum of 8.0 mm (0.31 in) ⓒ.

12. Connect the throttle cable joint, install the clip, and then tighten the locknut.
13. Check the throttle cable for smooth operation and, if necessary, repeat steps 2–12.
14. Install the intake silencer.

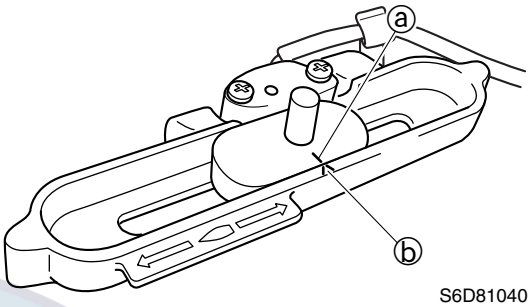
Checking the gear shift operation

1. Check that the gear shift operates smoothly when shifting it from neutral to forward or reverse. Adjust the shift cable length if necessary.
2. Set the gear shift to the neutral position.
3. Loosen the locknut ①, remove the clip ②, and then disconnect the shift cable joint ③.
4. Remove the clip ④.



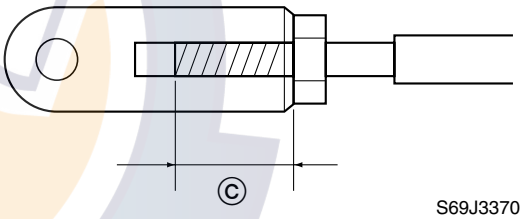
S6D83140

5. Align the alignment mark ⓐ on the bushing and alignment mark ⓑ on the bracket.



S6D81040

6. Install the clip ④.
7. Adjust the position of the shift cable joint until its hole is aligned with the set pin.



S69J3370

⚠ WARNING

The shift cable joint must be screwed in a minimum of 8.0 mm (0.31 in) ⓒ.

8. Connect the cable joint, install the clip, and then tighten the locknut.
9. Check the gear shift for smooth operation and, if necessary, repeat steps 2–8.

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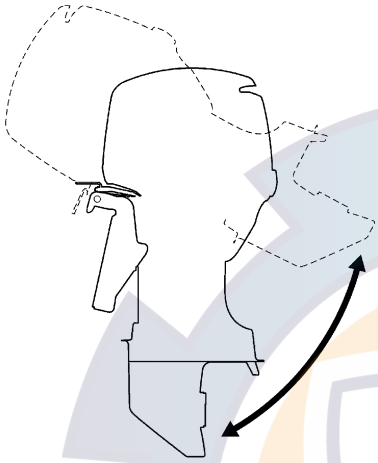
Bracket unit

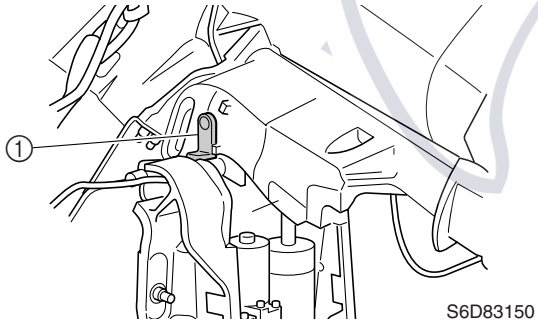
Checking the power trim and tilt operation

1. Fully tilt the outboard motor up and down a few times and check the entire trim and tilt range for smooth operation. Check the power trim and tilt fluid level if necessary.


S6C13220

NOTE:
Be sure to listen to the winding sound of the power trim and tilt motor for smooth operation.

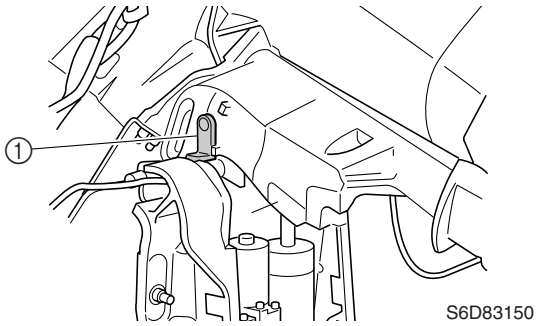
2. Fully tilt the outboard motor up, and then support it with the tilt stop lever ① to check the lock mechanism of the lever.



S6D83150

Checking the power trim and tilt fluid level

1. Fully tilt the outboard motor up, and then support it with the tilt stop lever ①.

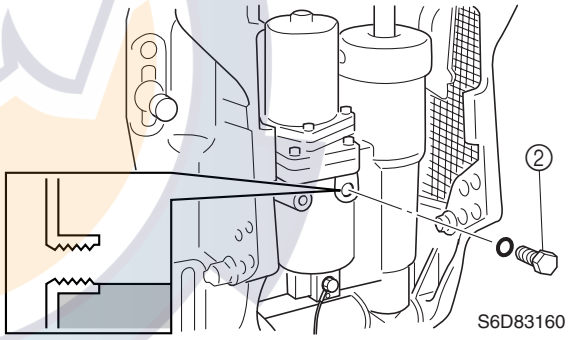


S6D83150

⚠ WARNING

After tilting up the outboard motor, be sure to support it with the tilt stop lever. Otherwise, the outboard motor could suddenly lower if the power trim and tilt unit should lose fluid pressure.

2. Remove the reservoir cap ②, and then check the fluid level in the reservoir.



S6D83160

NOTE:
If the fluid is at the correct level, the fluid should overflow out of the filler hole when the reservoir cap is removed.

3. If necessary, add sufficient fluid of the recommended type until it overflows out of the filler hole.

Recommended power trim and tilt fluid:
ATF Dexron II

4. Install the reservoir cap, and then tighten it to the specified torque.

Reservoir cap:
7 N·m (0.7 kgf·m, 5.2 ft·lb)

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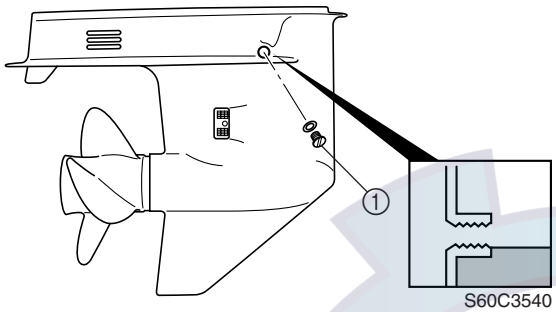
Lower unit

Checking the gear oil level

1. Fully tilt the outboard motor down.

2. Remove the check screw ①, and then check the gear oil level in the lower case.



S60C3540

NOTE:
If the oil is at the correct level, the oil should overflow out of the check hole when the check screw is removed.

3. If necessary, add sufficient gear oil of the recommended type until it overflows out of the check hole.

Recommended gear oil:
GEAR CASE LUBE
SAE: 90

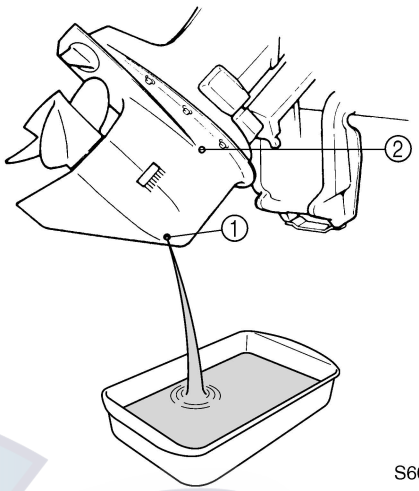
4. Install the check screw, and then tighten it to the specified torque.

Gear oil check screw:
9 N·m (0.9 kgf·m, 6.6 ft·lb)

Changing the gear oil

1. Tilt the outboard motor up slightly.

2. Place a drain pan under the drain screw ①, remove the drain screw, then the check screw ② and let the oil drain completely.



S60V3330

3. Check the oil for metal and discoloration, and its viscosity. Check the internal parts of the lower case if necessary.

3

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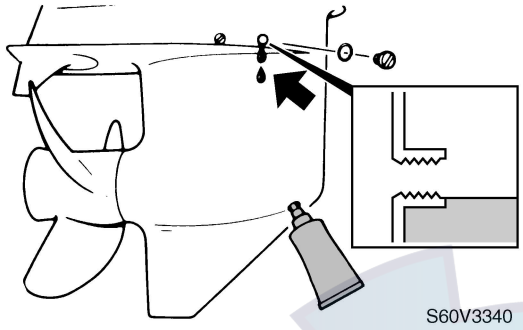
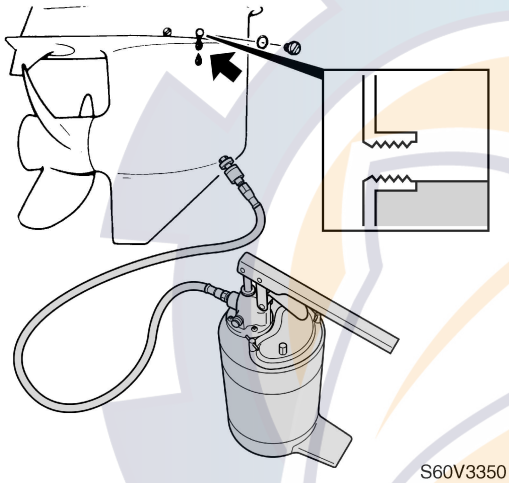
4. Insert a gear oil tube or gear oil pump into the drain hole and slowly fill the gear oil until oil flows out of the check hole and no air bubbles are visible.


S60V3340


S60V3350

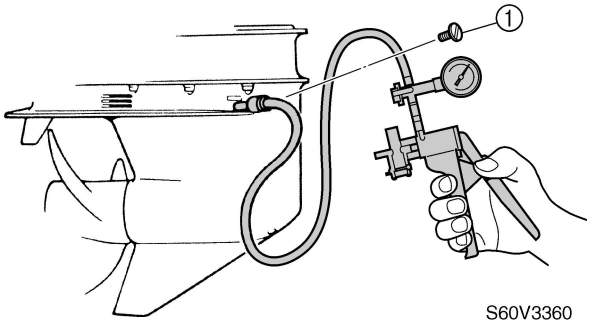
Recommended gear oil:
GEAR CASE LUBE
SAE: 90
Gear oil quantity:
670 cm^3 (22.7 US oz, 23.6 Imp oz)

5. Install the check screw and quickly install the drain screw, and then tighten them to the specified torque.

Gear oil check screw and drain screw:
9 N·m (0.9 kgf·m, 6.6 ft·lb)

Checking the lower unit for air leakage

1. Remove the check screw ①, and then install the special service tool.



S60V3360

Pressure/vacuum tester:
YB-35956-A

2. Apply the specified pressure to check that the pressure is maintained in the lower unit for at least 10 seconds.

CAUTION:
Do not over pressurize the lower unit, otherwise the oil seals can be damaged.

NOTE:
Cover the check hole with a rag when removing the tester from the lower unit.

Lower unit holding pressure:
100 kPa (1.0 kgf/cm^2, 14.5 psi)

3. If pressure drops below specification, check the drive shaft and propeller shaft oil seals for damage.

Checking the propeller

1. Check the propeller blades and splines for cracks, damage, or wear. Replace if necessary.

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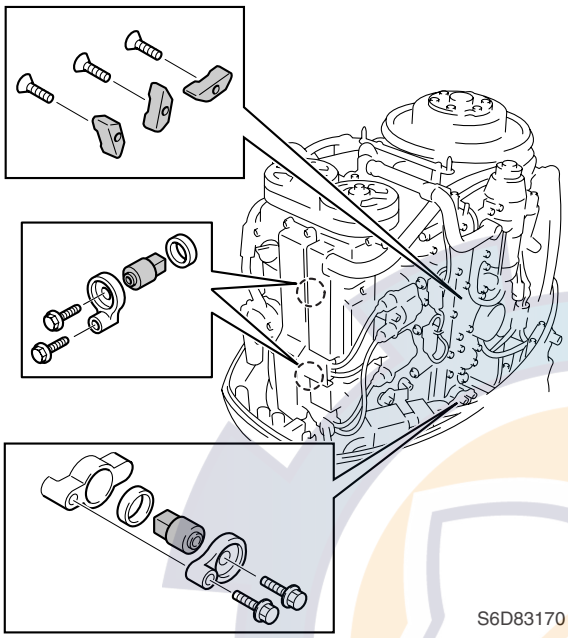
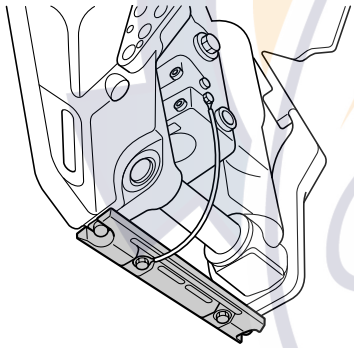
General

Checking the anodes

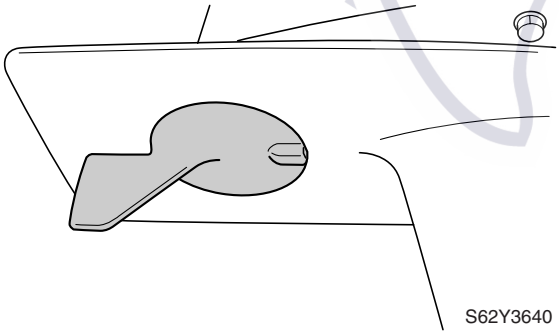
1. Check the anodes and trim tab for scales, grease, or oil. Clean if necessary.



S6D83170



S6D83210



S62Y3640

CAUTION:

Do not oil, grease, or paint the anodes or the trim tab, otherwise they will be ineffective.

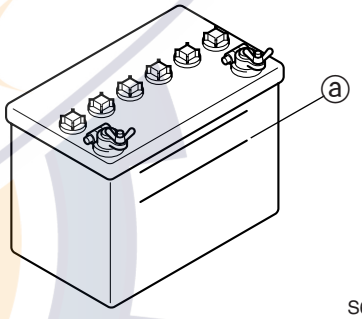
NOTE:

If it is necessary to disassemble the outboard motor to check an anode, refer to the applicable disassembly procedure in this manual.

2. Replace the anodes or trim tab if excessively eroded.

Checking the battery

1. Check the battery electrolyte level. If the level is at or below the minimum level mark ⓐ, add distilled water until the level is between the maximum and minimum level marks.



S69J3620

3

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2. Check the specific gravity of the electrolyte. Fully charge the battery if out of specification.

⚠ WARNING

Battery electrolyte is dangerous; it contains sulfuric acid which is poisonous and highly caustic.
Always follow these preventive measures:
- **Avoid bodily contact with electrolyte as it can cause severe burns or permanent eye injury.**
- **Wear protective eye gear when handling or working near batteries.**

Antidote (EXTERNAL):
- **SKIN – Wash with water.**
- **EYES – Flush with water for 15 minutes and get immediate medical attention.**

Antidote (INTERNAL):
- **Drink large quantities of water or milk followed with milk of magnesia, beaten egg, or vegetable oil. Get immediate medical attention.**

Batteries generate explosive, hydrogen gas. Always follow these preventive measures:
- **Charge batteries in a well-ventilated area.**
- **Keep batteries away from fire, sparks or open flames (e.g., welding equipment, lighted cigarettes).**
- **DO NOT SMOKE when charging or handling batteries.**

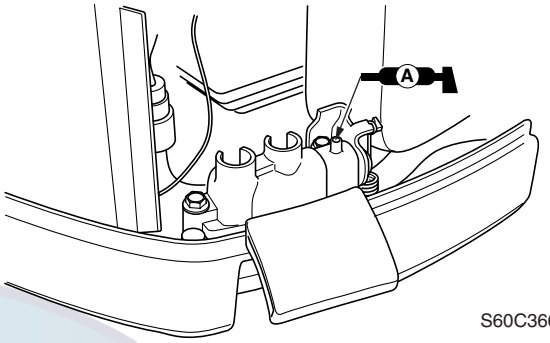
KEEP BATTERIES AND ELECTROLYTE OUT OF REACH OF CHILDREN.

NOTE:
- Batteries vary per manufacturer. The procedures mentioned in this manual may not always apply, therefore, consult the instruction manual of the battery.
- Disconnect the negative battery lead first, then the positive battery lead.

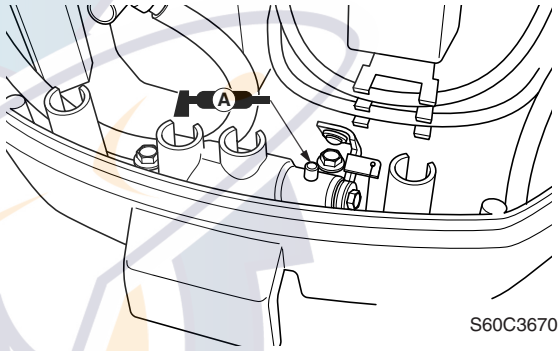
Electrolyte specific gravity:
1.280 at 20 °C (68 °F)

Lubricating the outboard motor

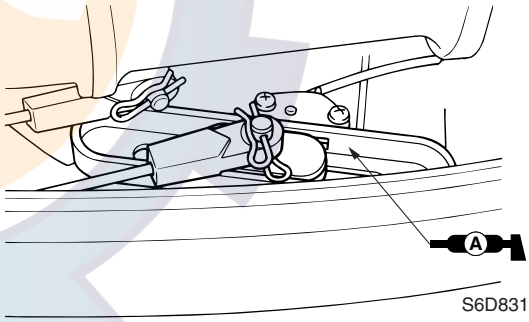
1. Apply water resistant grease to the areas shown.



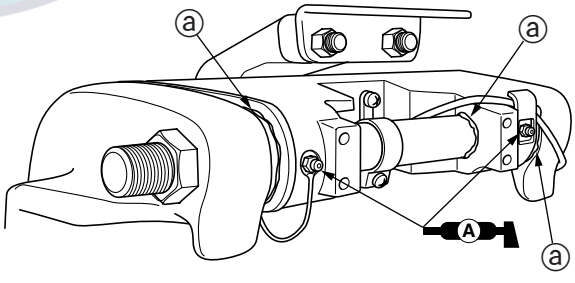
S60C3660



S60C3670



S6D83180



S60C3695

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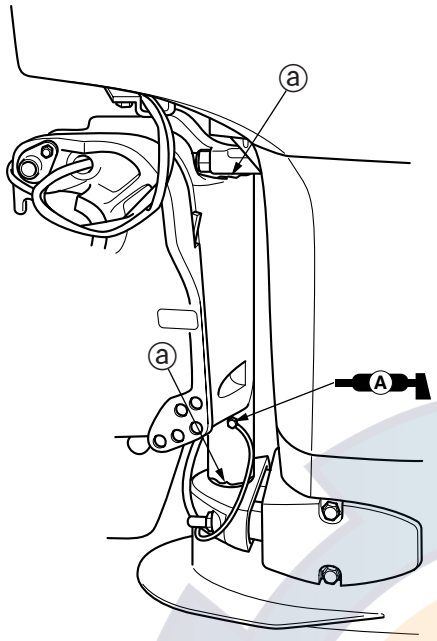
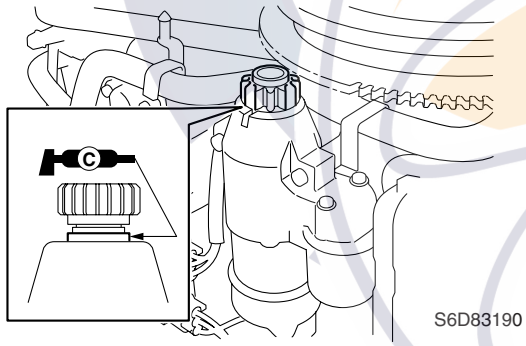


S60C3710

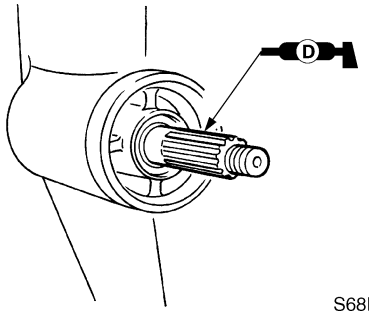
NOTE:
Apply grease to the grease nipple until it flows from the bushings ⓐ.

2. Apply low temperature resistant grease to the area shown.



S6D83190

3. Apply corrosion resistant grease to the area shown.



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Fuel system

Special service tools **4-1**

Hose routing **4-2**
Fuel and blowby hoses 4-2

Fuel filter and fuel pump **4-3**
Checking the fuel pump 4-5
Disassembling the fuel pump 4-5
Checking the diaphragm and valves 4-6
Assembling the fuel pump 4-6

Intake manifold **4-7**
Checking the throttle position sensor 4-9
Installing the throttle position sensor 4-9
Checking the idle speed control 4-9

Vapor separator **4-10**
Reducing the fuel pressure 4-13
Disconnecting the quick connector 4-13
Measuring the fuel pressure 4-13
Checking the pressure regulator 4-14
Draining the fuel 4-15
Removing the fuel hose clamp 4-15
Installing the fuel hose clamp 4-15
Disassembling the vapor separator 4-15
Checking the vapor separator 4-16
Assembling the vapor separator 4-16
Adjusting the float 4-17

Canister **4-18**
Checking the canister 4-19

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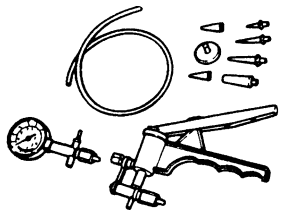
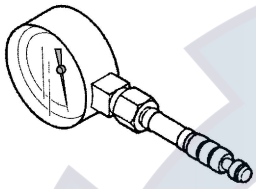
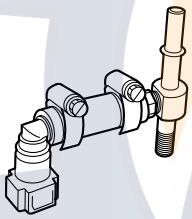
Special service tools



Pressure/vacuum tester
YB-35956-A



Fuel pressure gauge
YB-06766



Fuel pressure gauge adapter B
YB-06942

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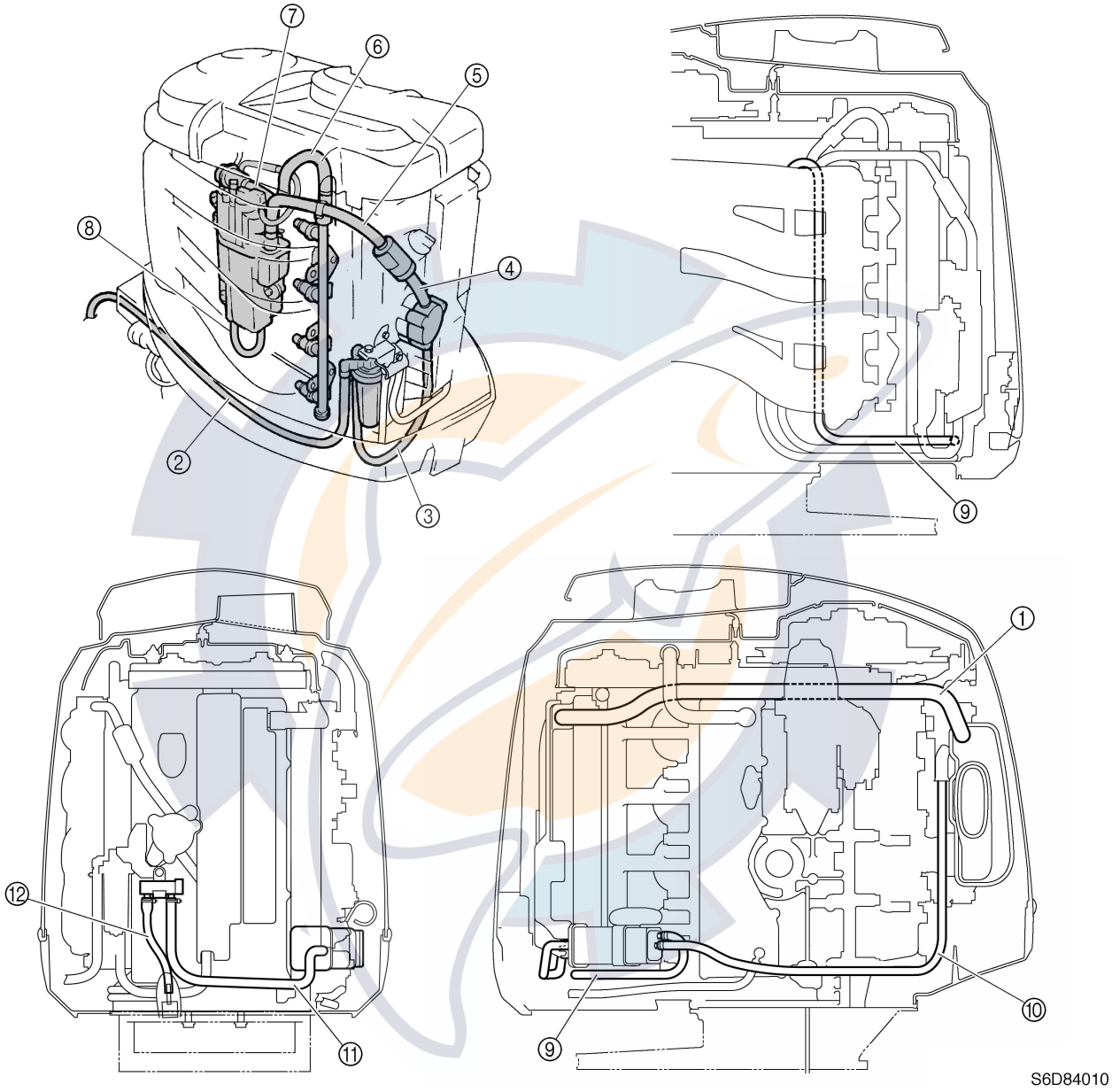
Hose routing

Fuel and blowby hoses



① Blowby hose
② Fuel hose (primary pump-to-fuel filter)
③ Fuel hose (fuel filter-to-fuel pump)
④ Fuel hose (fuel pump-to-strainer)
⑤ Fuel hose (strainer-to-vapor separator)
⑥ High-pressure fuel hose (vapor separator-to-fuel rail)
⑦ Fuel hose (pressure regulator-to-fuel cooler)
⑧ Fuel hose (fuel cooler-to-vapor separator)
⑨ Canister hose (vapor separator-to-canister)
⑩ Canister hose (canister-to-idle speed control)
⑪ Canister hose (canister-to-filter)
⑫ Canister hose (filter-to-bottom cowling)

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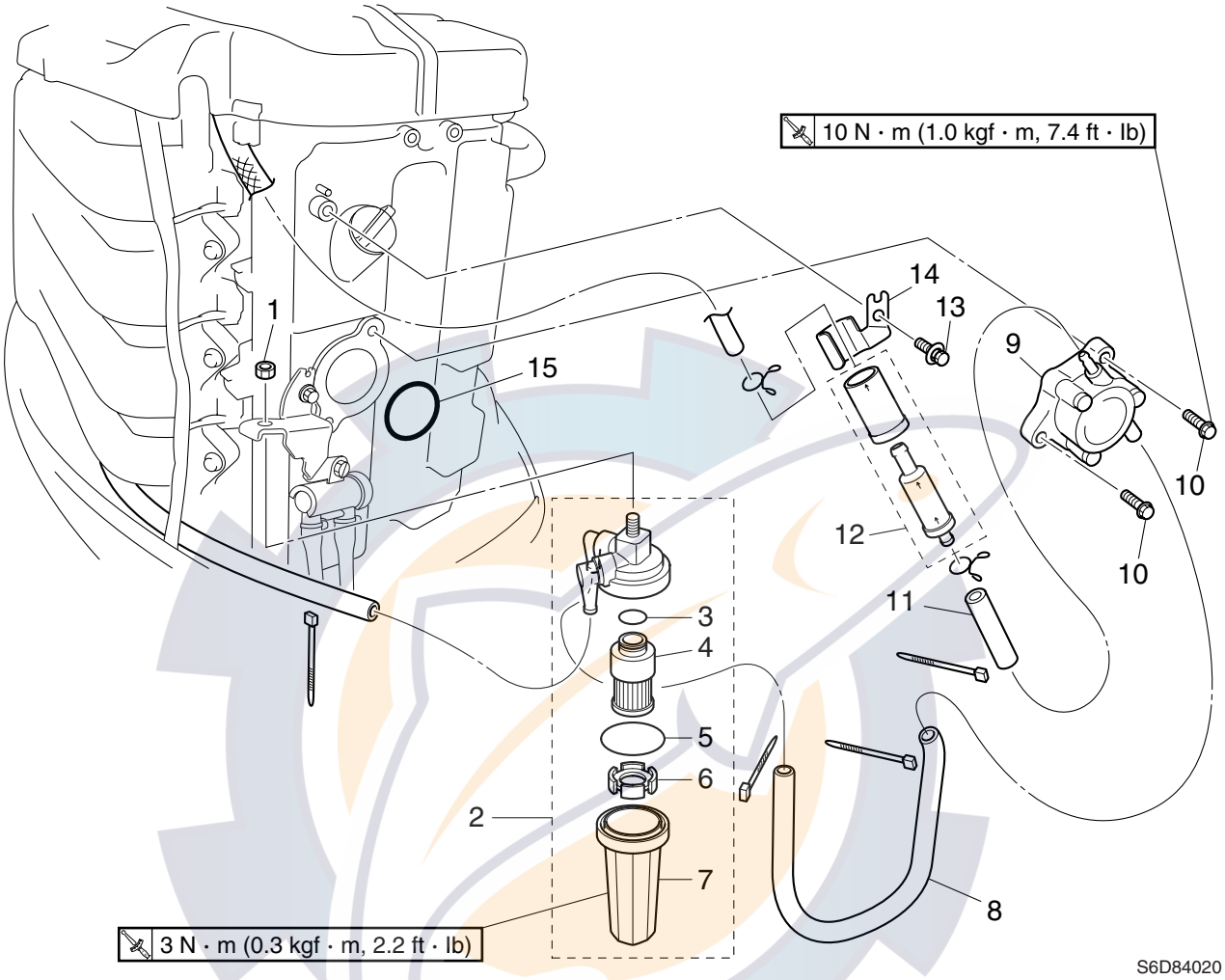
Fuel filter and fuel pump



No.	Part name	Q'ty	Remarks
1	Nut	1	
2	Fuel filter assembly	1	
3	O-ring	1	**Not reusable**
4	Fuel filter element	1	
5	O-ring	1	**Not reusable**
6	Float	1	
7	Cup	1	
8	Fuel hose	1	
9	Fuel pump	1	
10	Bolt	2	M6 × 30 mm
11	Fuel hose	1	
12	Strainer	1	
13	Bolt	1	M6 × 12 mm
14	Bracket	1	
15	O-ring	1	**Not reusable**

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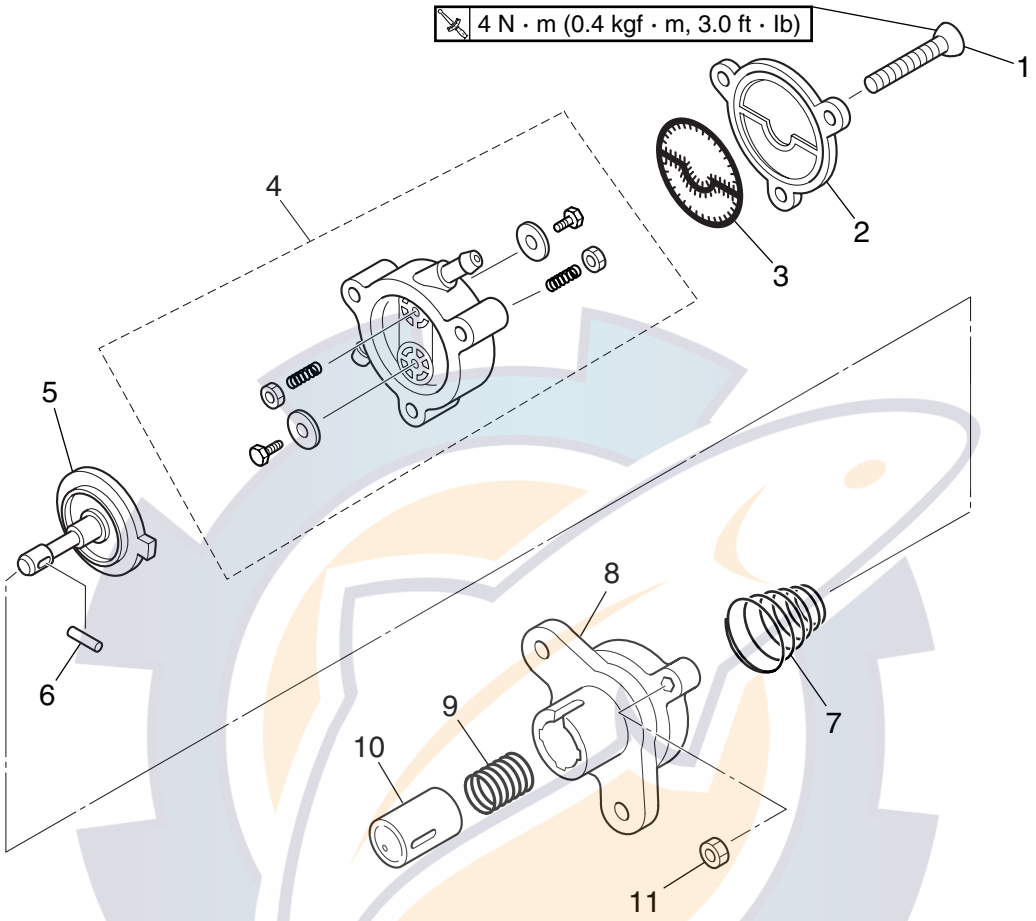

S6D84030

No.	Part name	Q'ty	Remarks
1	Screw	3	ø6 × 35 mm
2	Cover	1	
3	Gasket	1	**Not reusable**
4	Fuel pump body 2 assembly	1	
5	Diaphragm	1	
6	Pin	1	
7	Spring	1	
8	Fuel pump body 1	1	
9	Spring	1	
10	Plunger	1	
11	Nut	3	

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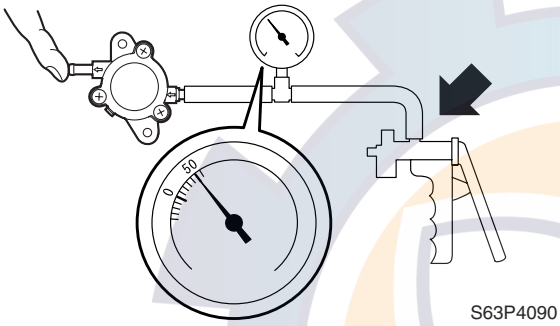
Checking the fuel pump

1. Place a drain pan under the fuel hose connections, and then disconnect the fuel hoses from the fuel pump.
2. Connect the special service tool to the fuel pump inlet.
3. Cover the fuel pump outlet with a finger, and then apply the specified positive pressure. Check that there is no air leakage.

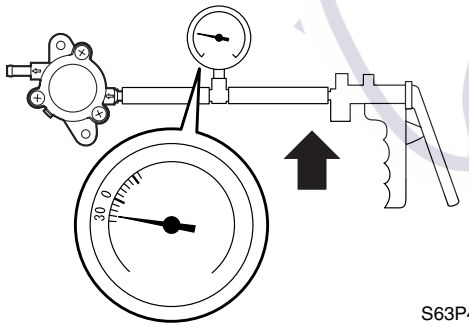


S63P4090

Pressure/vacuum tester:
YB-35956-A

Specified pressure:
50 kPa (0.5 kgf/cm^2, 7.3 psi)

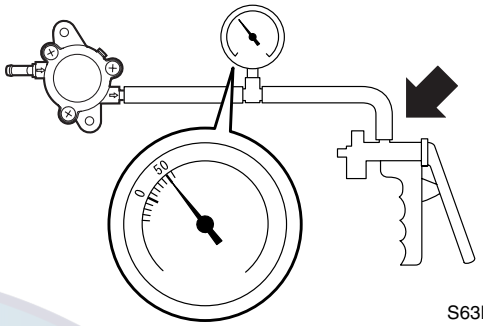
4. Apply the specified negative pressure and check that there is no air leakage.



S63P4100

Specified pressure:
30 kPa (0.3 kgf/cm^2, 4.4 psi)

5. Connect the special service tool to the fuel pump outlet.
6. Apply the specified positive pressure and check that there is no air leakage. Disassemble the fuel pump if necessary.



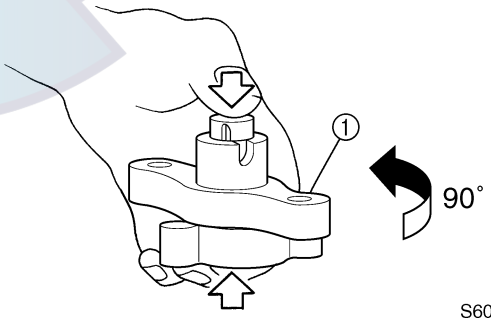
S63P4110

NOTE:
Assemble the fuel pump valve to the fuel pump body, and moisten the inside of the fuel pump with gasoline to ensure a good seal.

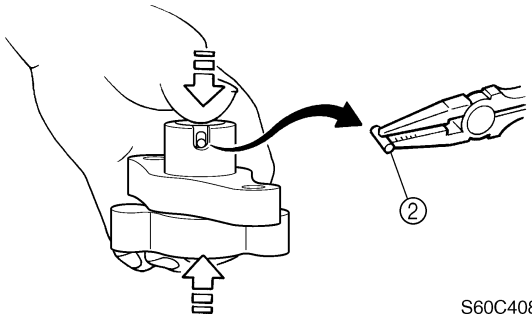
Specified pressure:
50 kPa (0.5 kgf/cm^2, 7.3 psi)

Disassembling the fuel pump

1. Disassemble the fuel pump.
2. Push down on the plunger and the diaphragm, turn fuel pump body 1 ① approximately 90° to a position where the pin ② can be removed easily, and then remove the pin.



S60C4070



S60C4080

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3. Slowly let up on the plunger and diaphragm, and then remove them.

Checking the diaphragm and valves

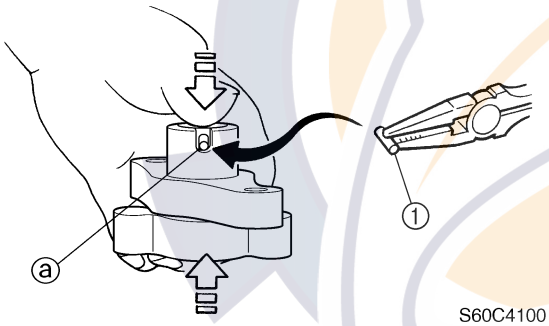
1. Check the diaphragm for tears and the valves for cracks. Replace if necessary.

Assembling the fuel pump

NOTE:
Clean the parts and soak the valves and the diaphragm in gasoline before assembly to obtain prompt operation of the fuel pump when starting the engine.

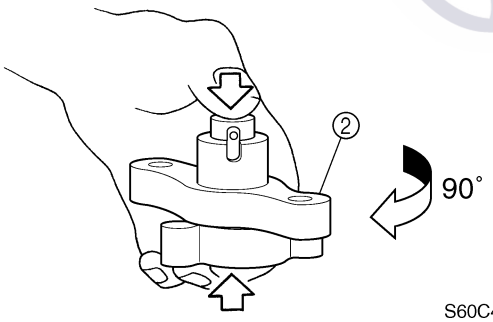
1. Align the plunger and diaphragm installation holes ⓐ, and then install the plunger into the diaphragm.

2. Push down on the plunger and the diaphragm, and then install the pin ①.



S60C4100

3. Turn fuel pump body 1 ② approximately 90°, and then push down on the plunger several times to make sure that the pin does not come out.



S60C4110

NOTE:
Make sure that the gasket and diaphragm are kept in place through the assembly process.

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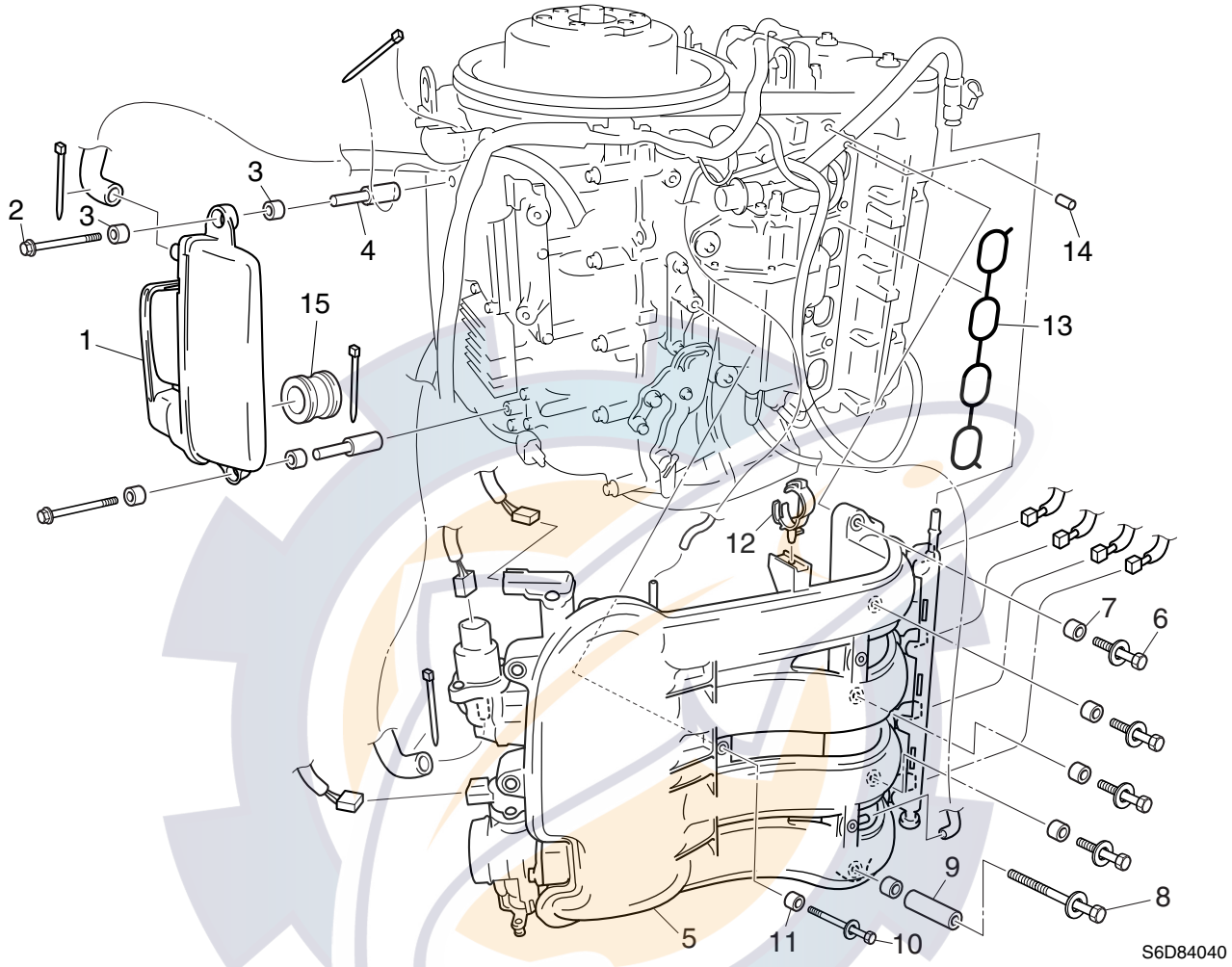
Intake manifold



No.	Part name	Q'ty	Remarks
1	Intake silencer	1	
2	Bolt	2	M6 × 80 mm
3	Bushing	4	
4	Collar	2	
5	Intake manifold assembly	1	
6	Bolt	4	M8 × 30 mm
7	Collar	5	
8	Bolt	1	M8 × 100 mm
9	Spacer	1	
10	Bolt	3	M6 × 45 mm
11	Collar	3	
12	Holder	1	
13	Gasket	1	**Not reusable**
14	Pin	2	
15	Joint	1	

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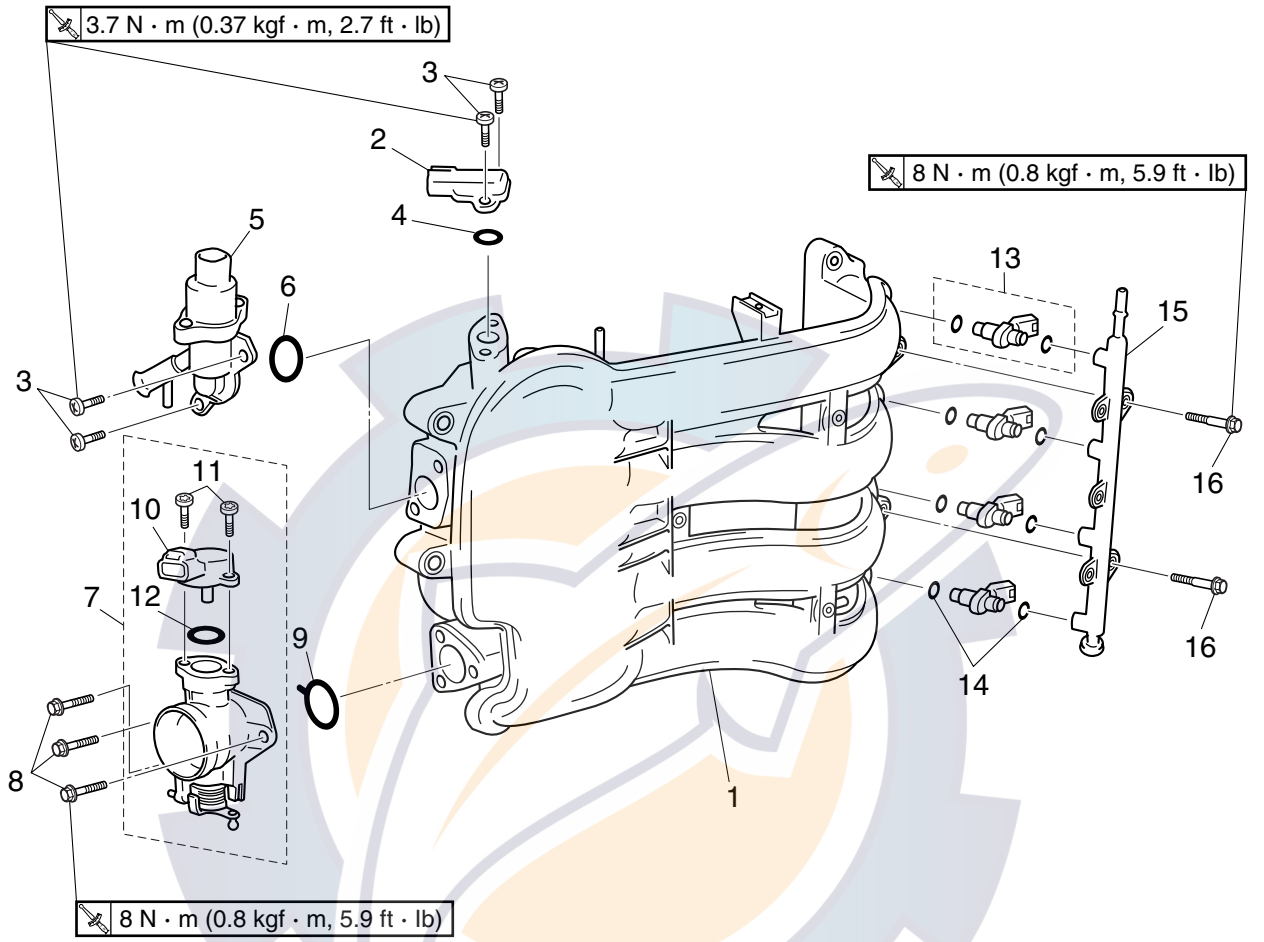

No.	Part name	Q'ty	Remarks
1	Intake manifold	1	
2	Sensor assembly	1	
3	Screw	4	ø5 × 13 mm
4	O-ring	1	**Not reusable**
5	Idle speed control	1	
6	O-ring	1	**Not reusable**
7	Throttle body assembly	1	
8	Bolt	3	M6 × 16 mm
9	Gasket	1	**Not reusable**
10	Throttle position sensor	1	
11	Screw	2	
12	O-ring	1	**Not reusable**
13	Fuel injector	4	
14	O-ring set	4	**Not reusable**
15	Fuel rail	1	
16	Bolt	1	M6 × 38 mm

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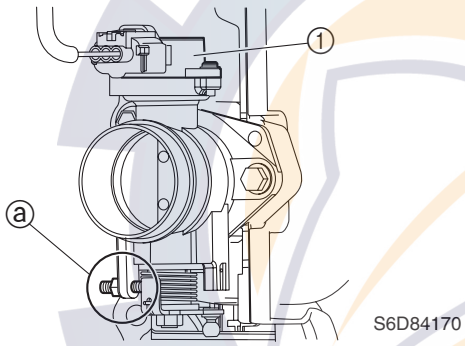
Checking the throttle position sensor

1. Check the throttle position sensor output voltage using the Yamaha Diagnostic System. If the output voltage is out of specification, replace the throttle position sensor.

Throttle position sensor output voltage at engine idle speed:
0.8–1.2 V

Installing the throttle position sensor

1. Install the throttle position sensor ① in a position where the output voltage is within specification.



NOTE:
- If the throttle position sensor output voltage is out of specification, reinstall the throttle position sensor.
- Measure the throttle position sensor output voltage using the Yamaha Diagnostic System.
- Do not turn the throttle stop screw ⓐ.

Throttle position sensor output voltage at engine idle speed:
0.8–1.2 V

Checking the idle speed control

1. Check the operation of the idle speed control using the Yamaha Diagnostic System.

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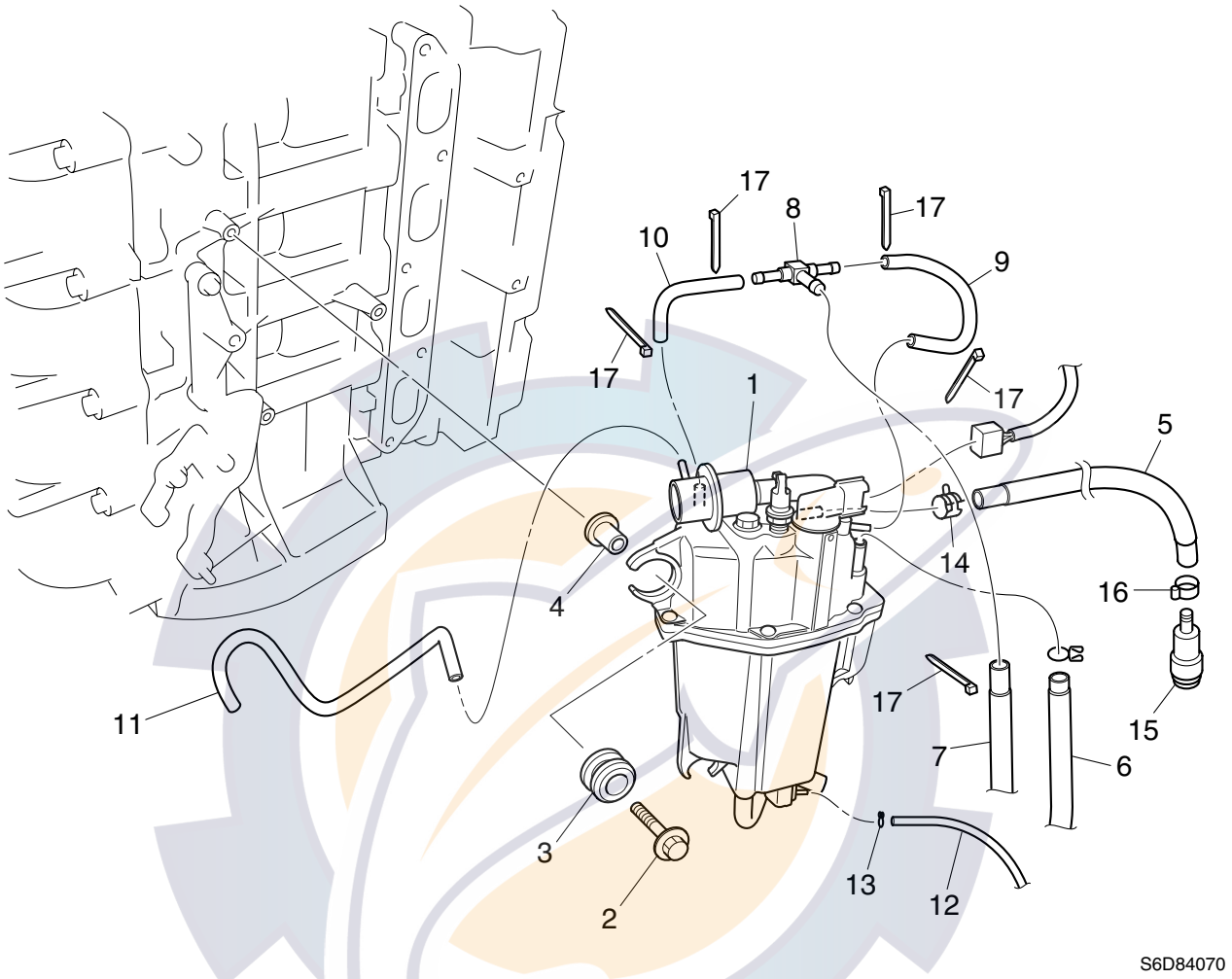
Vapor separator



No.	Part name	Q'ty	Remarks
1	Vapor separator	1	
2	Bolt	3	M6 × 30 mm
3	Grommet	3	
4	Collar	3	
5	Fuel hose	1	
6	Fuel inlet hose	1	
7	Hose	1	
8	Joint	1	
9	Hose	1	
10	Hose	1	
11	Hose	1	
12	Hose	1	
13	Clamp	1	
14	Clamp	1	
15	Quick connector	1	
16	Clamp	1	**Not reusable**
17	Plastic tie	5	**Not reusable**

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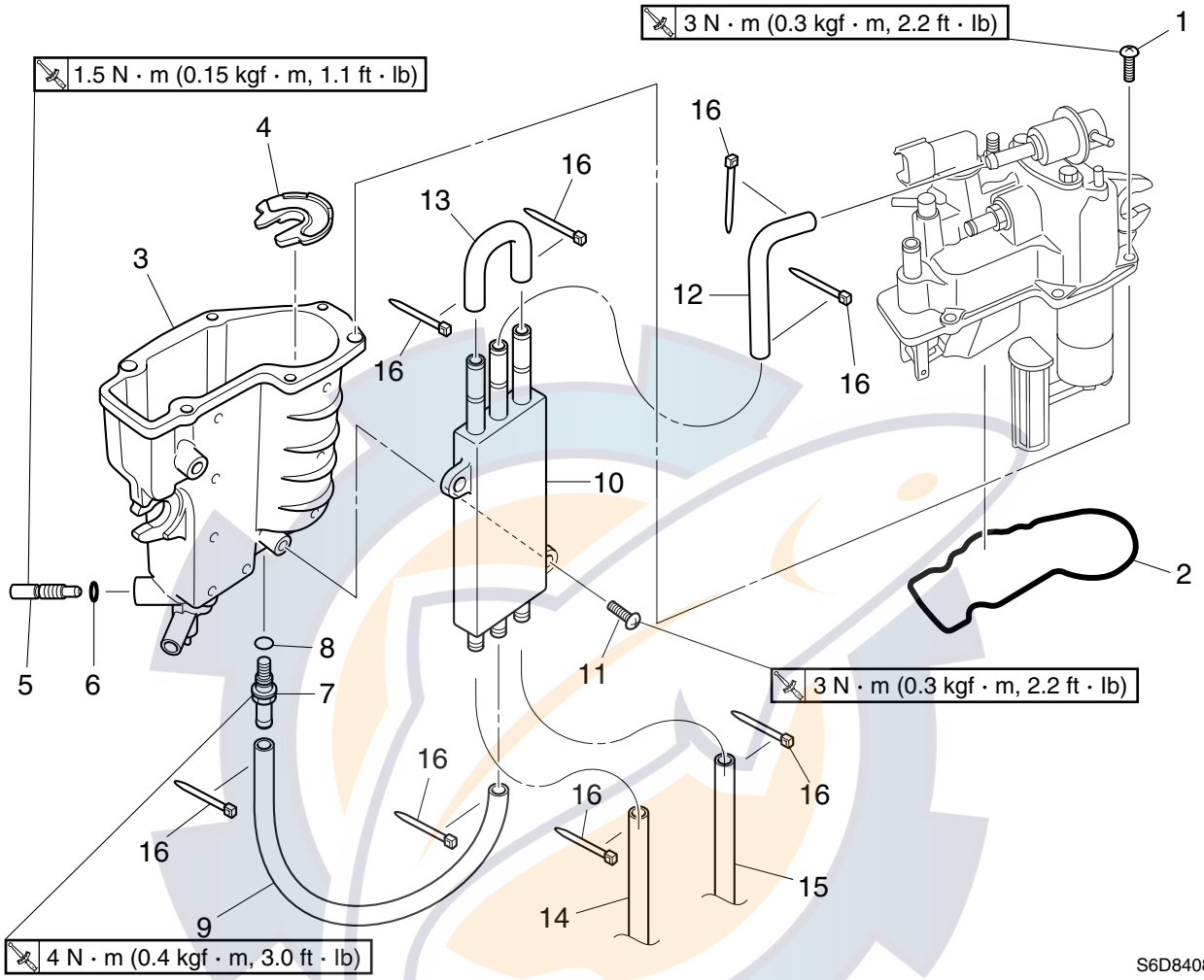

No.	Part name	Q'ty	Remarks
1	Screw	6	ø5 × 14 mm
2	Gasket	1	**Not reusable**
3	Float chamber	1	
4	Damper	1	
5	Drain screw	1	
6	O-ring	1	**Not reusable**
7	Joint screw	1	
8	O-ring	1	**Not reusable**
9	Fuel hose	1	
10	Fuel cooler	1	
11	Screw	2	ø6 × 15 mm
12	Fuel hose	1	
13	Hose	1	
14	Hose	1	
15	Hose	1	
16	Plastic tie	8	**Not reusable**

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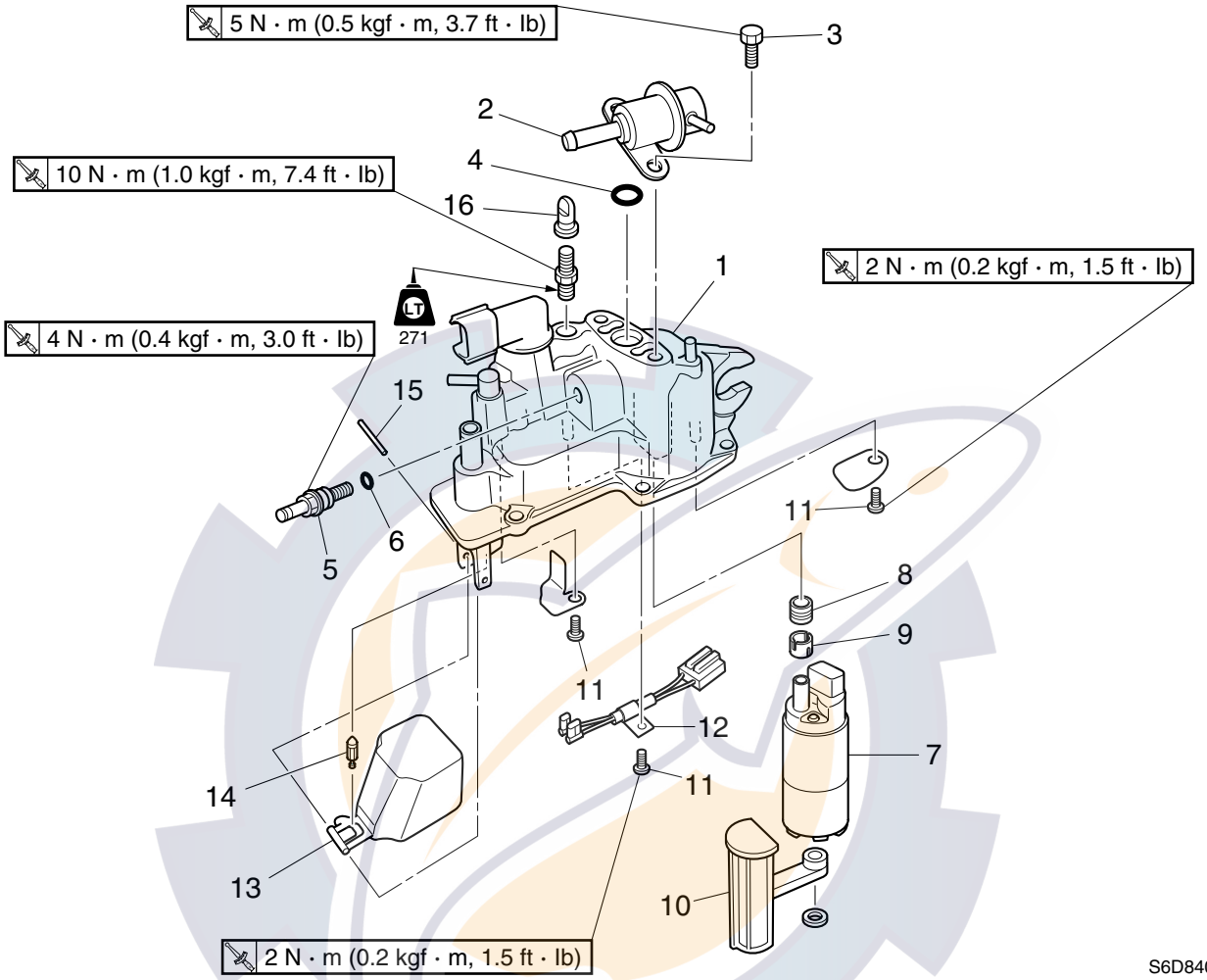

No.	Part name	Q'ty	Remarks
1	Cover	1	
2	Pressure regulator	1	
3	Bolt	2	M6 × 12 mm
4	O-ring	1	**Not reusable**
5	Joint screw	1	
6	O-ring	1	**Not reusable**
7	Electric fuel pump	1	
8	Grommet	1	
9	Collar	1	
10	Filter	1	
11	Screw	3	ø4 × 6 mm
12	Wiring harness	1	
13	Float	1	
14	Needle valve	1	
15	Pin	1	**Not reusable**
16	Cap	1	

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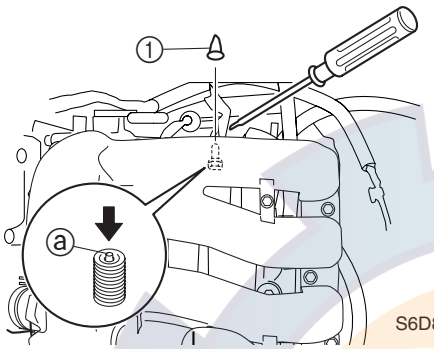
Reducing the fuel pressure

1. Remove the cap ①.
2. Cover the pressure check valve ⓐ of the vapor separator with a rag, and then press in the pressure check valve ⓐ using a thin screwdriver to release the fuel pressure.



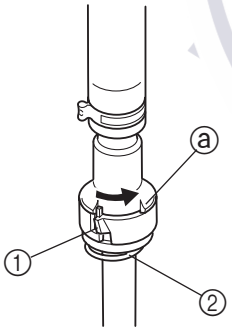
S6D84180

⚠ WARNING

Always reduce the fuel pressure in the high-pressure fuel line before servicing the line or the vapor separator. If the fuel pressure is not released, pressurized fuel may spray out.

Disconnecting the quick connector

1. Wrap the quick connector with a cloth, and then rotate the quick connector tab ① to the stopper position ⓐ.



S6C14240

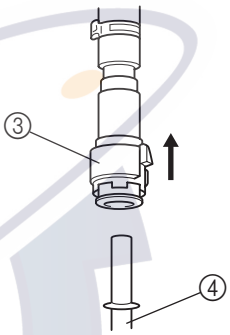
⚠ WARNING

If the quick connector is removed suddenly, pressurized fuel could spray out. To gradually release the fuel pressure, be sure to remove the quick connector slowly.

CAUTION:

- **Do not rotate the quick connector tab ① past the stopper position ⓐ, otherwise it could be damaged.**
- **When the fuel hose is disconnected, quickly remove the retainer ② from the quick connector, otherwise the retainer could be lost.**

2. Disconnect the quick connector ③ from the fuel rail ④ directly.



S6C14250

⚠ WARNING

Always reduce the fuel pressure in the fuel line before servicing the line or the fuel pipe. If the fuel pressure is not released, pressurized fuel could spray out.

Measuring the fuel pressure

1. Disconnect the quick connector from the fuel rail.

NOTE:

Before disconnecting the quick connector, release the fuel pressure.

2. Connect fuel pressure gauge adapter B ① between the quick connector and fuel rail.
3. Connect the fuel pressure gauge ② to fuel pressure gauge adapter B.

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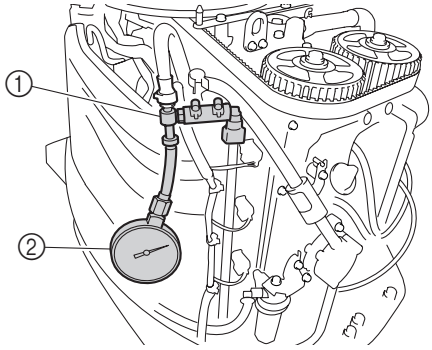


S6D84110

⚠ WARNING

- **When connecting the fuel pressure gauge, first cover the connection between the gauge and the adapter with a clean, dry rag to prevent fuel from leaking out.**
- **Gently screw in the gauge until it is firmly connected.**

Fuel pressure gauge adapter B ①: YB-06942
Fuel pressure gauge ②: YB-06766

4. Turn the engine start switch to ON, and then measure the fuel pressure within 3 seconds.

NOTE:
The fuel pressure decreases 3 seconds after the engine start switch is turned to ON.

Fuel pressure (reference data):
300 kPa (3.0 kgf/cm^2, 43.5 psi)

5. Measure the fuel pressure 3 seconds after turning the engine start switch to ON.

Fuel pressure (reference data):
260 kPa (2.6 kgf/cm^2, 37.7 psi)

6. Start the engine, warm it up for 5 minutes, and then measure the fuel pressure. If below specification, check the high-pressure fuel line and the vapor separator.

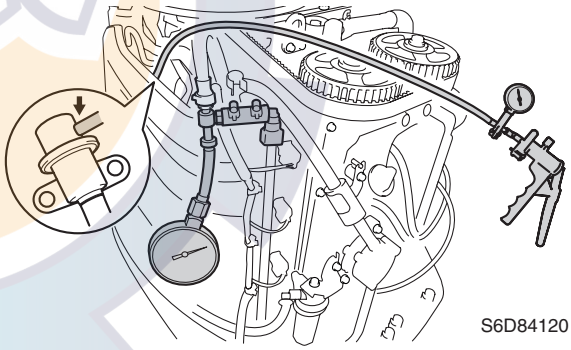
Fuel pressure (reference data):
230 kPa (2.3 kgf/cm^2, 33.4 psi)

Checking the pressure regulator

1. Disconnect the quick connector from the fuel rail.

NOTE:
Before disconnecting the quick connector, release the fuel pressure.

2. Connect fuel pressure gauge adapter B between the quick connector and fuel rail.
3. Connect the fuel pressure gauge to fuel pressure gauge adapter B.
4. Disconnect the pressure regulator hose, and then connect the special service tools to the pressure regulator.


S6D84120

⚠ WARNING

- **When connecting the fuel pressure gauge, first cover the connection between the gauge and the adapter with a clean, dry rag to prevent fuel from leaking out.**
- **Gently screw in the gauge until it is firmly connected.**

Fuel pressure gauge: YB-06766
Fuel pressure gauge adapter B: YB-06942
Pressure/vacuum tester: YB-35956-A

5. Start the engine and let it idle.

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6. Check that the fuel pressure reduces when vacuum pressure is applied to the pressure regulator. If the fuel pressure does not reduce, replace the pressure regulator.

NOTE:
When the vacuum pressure reaches the specified level, the fuel pressure reduces.

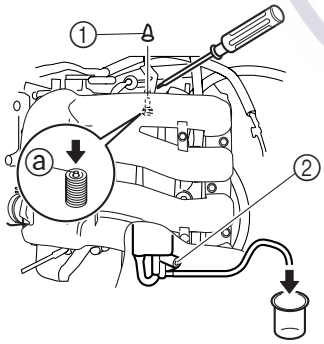
Draining the fuel

1. Remove the cap ①.
2. Cover the pressure check valve ⓐ of the vapor separator with a rag, and then press in the pressure check valve ⓐ using a thin screwdriver to release the fuel pressure.

⚠ WARNING

Always reduce the fuel pressure in the high-pressure fuel line before servicing the line or the vapor separator. If the fuel pressure is not released, pressurized fuel may spray out.

3. Place a container under the vapor separator drain hose, and then loosen the drain screw ②.
4. Drain the fuel from the vapor separator drain hose by pressing the pressure check valve using a thin screwdriver.



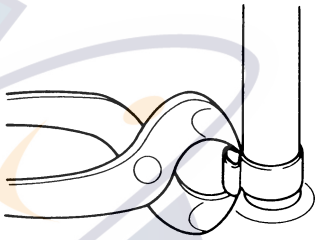
S6D84100

⚠ WARNING

Reduce the fuel pressure before loosening the vapor separator drain screw, or pressurized fuel will spray out and may result in serious injury.

Removing the fuel hose clamp

1. Remove the fuel hose clamp by cutting the crimped section of the clamp.

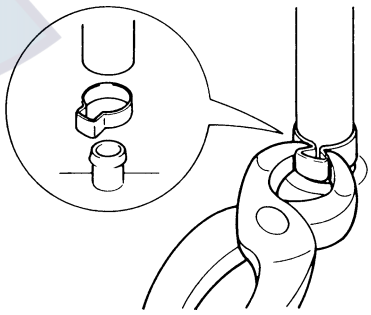

S69J4030

CAUTION:

If the fuel hose clamp is removed without cutting the crimp first, the fuel hose will be damaged.

Installing the fuel hose clamp

1. Crimp the fuel hose clamp properly to securely fasten it.


S69J4040

⚠ WARNING

Do not reuse the fuel hose clamp, always replace it with a new one.

Disassembling the vapor separator

1. Remove the float chamber, float pin, and float.

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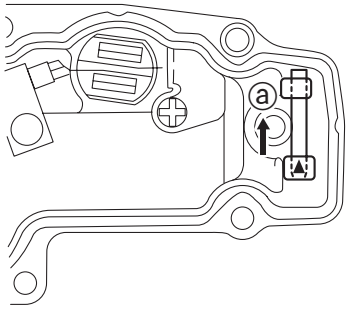


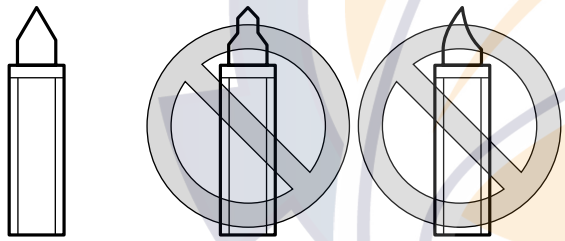
S6C14220

NOTE:
Remove the float pin in the direction of the arrow ⓐ shown.

2. Remove the needle valve and other components.

Checking the vapor separator

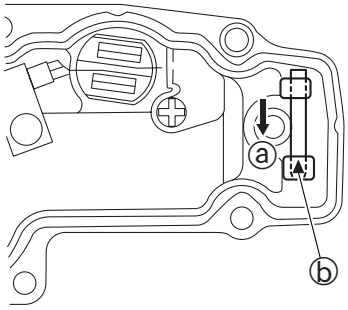
1. Check the needle valve for bends or wear. Replace if necessary.


S6D54200

2. Check the float for deterioration. Replace if necessary.
3. Check the filter for dirt or residue. Clean if necessary.

Assembling the vapor separator

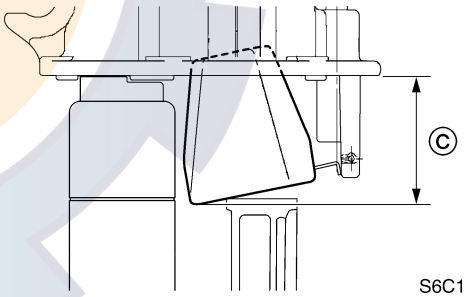
1. Install the needle valve, float, and float pin, and then check the float for smooth operation.



S6C14210

NOTE:
- Do not reuse the float pin, always replace it with a new one.
- Install the float pin in the direction of the arrow ⓐ shown.
- Install the float pin with its tapered end towards the punch mark ⓑ on the vapor separator cover.

2. Check the float height ⓒ as shown. Adjust the float height if out of specification.



S6C14280

Float height ⓒ:
46.6 ± 1.0 mm (1.83 ± 0.04 in)

4

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3. Check the float height ⓓ as shown. Adjust the float height if out of specification.

S6C14200

NOTE:
- The float should be resting on the needle valve, but not compressing it.
- Take measurements at the position shown, opposite the float pivot.

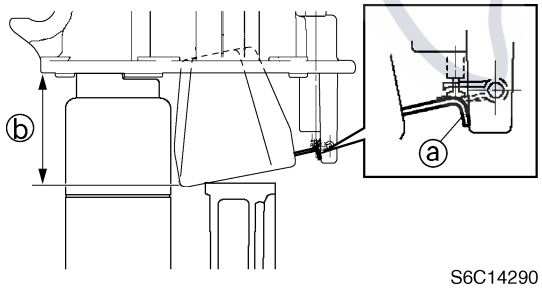
Float height ⓓ:
35.0 ± 1.0 mm (1.38 ± 0.04 in)

4. Install the float chamber.

Float chamber screw:
3 N·m (0.3 kgf·m, 2.2 ft·lb)

Adjusting the float

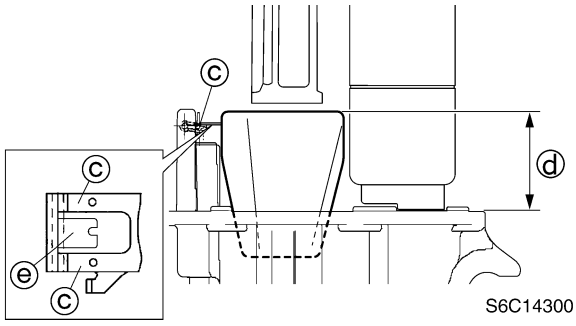
1. Adjust the stopper ⓐ of the float by bending it until the float height ⓑ is within specification.



S6C14290

Float height ⓑ:
46.6 ± 1.0 mm (1.83 ± 0.04 in)

2. Adjust the lever ⓒ of the float by bending it until the float height ⓓ is within specification.



S6C14300

Float height ⓓ:
35.0 ± 1.0 mm (1.38 ± 0.04 in)

NOTE:
When adjusting the float height, do not bend the lever ⓔ.

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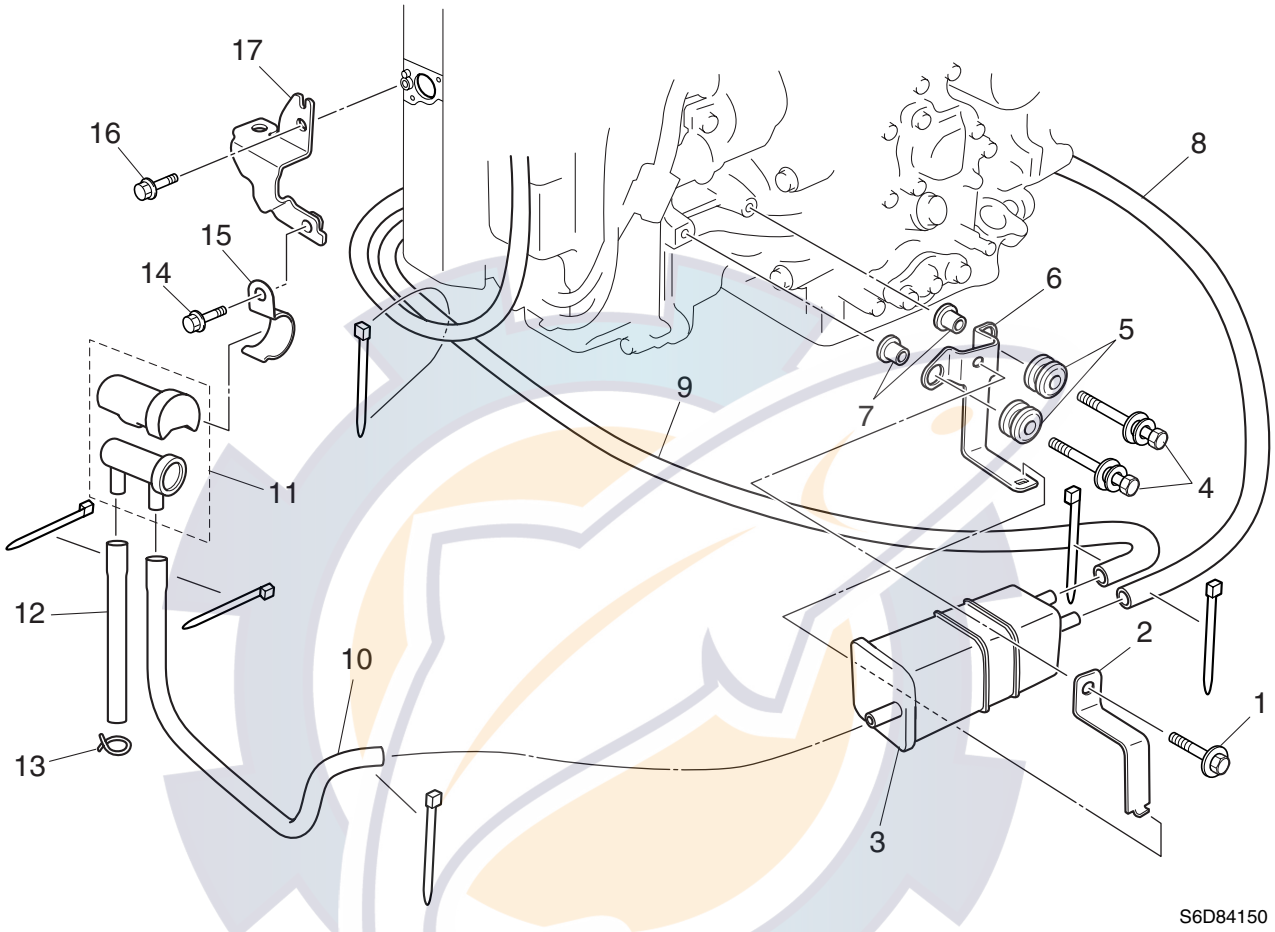
Canister



No.	Part name	Q'ty	Remarks
1	Bolt	1	M6 × 16 mm
2	Bracket	1	
3	Canister	1	
4	Bolt	2	M6 × 28 mm
5	Grommet	2	
6	Bracket	1	
7	Collar	2	
8	Hose	1	
9	Hose	1	
10	Hose	1	
11	Filter	1	
12	Hose	1	
13	Clamp	1	
14	Bolt	1	M6 × 10 mm
15	Holder	1	
16	Bolt	1	M6 × 16 mm
17	Bracket	1	

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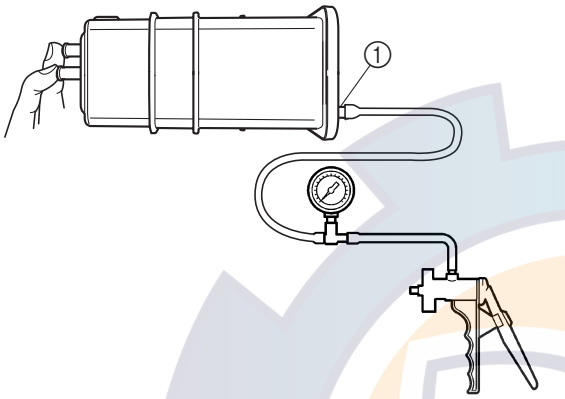
Checking the canister

1. Check the canister for cracks. Replace if necessary.

2. Connect the special service tool to the atmospheric port ① and cover the other ports, each with a finger.



S6D84160

3. Apply the specified positive pressure and check that there is no air leakage. Replace the canister if there is air leakage.

Pressure/vacuum tester:
YB-35956-A

Specified pressure:
19.6 kPa (0.196 kgf/cm^2, 2.8 psi)

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Power unit

Special service tools **5-1**

Power unit **5-3**
- Checking the compression pressure 5-3
- Checking the oil pressure 5-3
- Checking the valve clearance 5-10
- Replacing the timing belt 5-13
- Removing the power unit 5-16
- Removing the timing belt and sprockets 5-17
- Checking the timing belt and sprockets 5-18
- Installing the sprockets and timing belt 5-18

Throttle link **5-20**

ECM **5-21**

Junction box **5-22**

Cylinder head **5-24**
- Removing the cylinder head 5-26
- Checking the valve lifters 5-27
- Checking the valve springs 5-27
- Checking the valves 5-27
- Checking the valve guides 5-28
- Replacing the valve guides 5-28
- Checking the valve seat 5-29
- Refacing the valve seat 5-30
- Checking the camshafts 5-31
- Checking the cylinder head 5-32
- Installing the valves 5-33
- Installing the cylinder head 5-33

Exhaust cover **5-36**
- Removing the exhaust cover 5-38
- Checking the pressure control valve 5-38
- Installing the pressure control valve 5-38
- Installing the exhaust cover 5-38

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Cylinder block 5-39
Disassembling the cylinder block 5-40
Checking the piston diameter 5-40
Checking the cylinder bore 5-41
Checking the piston clearance 5-41
Checking the piston rings 5-41
Checking the piston ring grooves 5-42
Checking the piston ring side clearance 5-42
Checking the connecting rod big end side clearance 5-43
Checking the crankshaft 5-43
Checking the crankpin oil clearance 5-43
Selecting the connecting rod bearing 5-45
Checking the crankshaft journal oil clearance 5-46
Selecting the main bearing 5-47
Assembling the power unit 5-49
Installing the power unit 5-51

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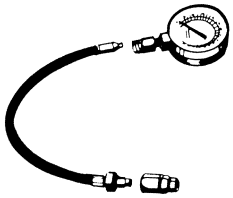
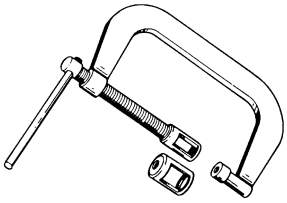
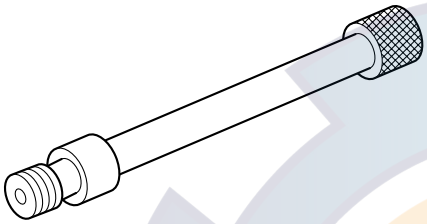
Special service tools



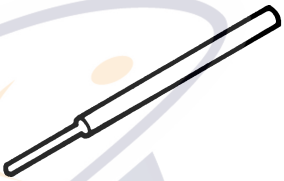
Compression gauge
YU-33223



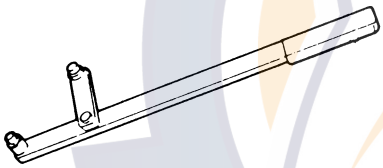
Valve spring compressor
YM-01253
Valve spring compressor attachment
YB-06320



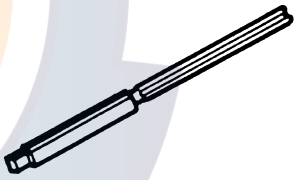
Compression gauge extension
YB-06563



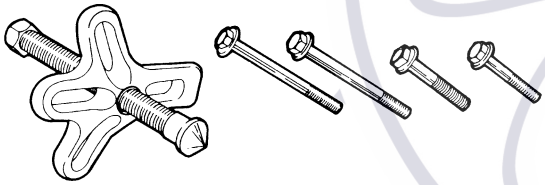
Valve guide remover/installer
YM-04064-A



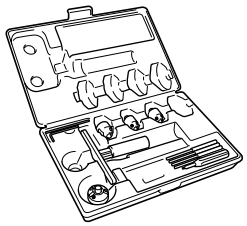
Flywheel magnet holder
YB-06139



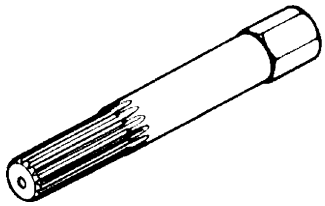
Valve guide reamer
YM-04066



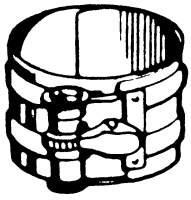
Universal puller
YB-06117



Neway valve seat kit
YB-91044



Crankshaft holder
YB-06552



Piston ring compressor
YM-08037

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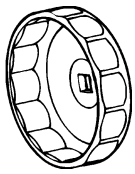

Oil filter wrench
YU-38411

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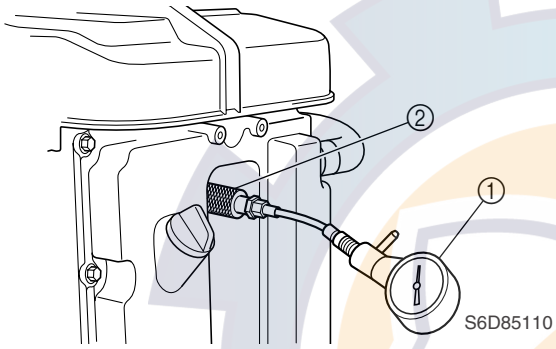
Power unit

Checking the compression pressure

1. Start the engine, warm it up for 5 minutes, and then turn it off.
2. Remove the engine stop lanyard from the engine stop lanyard switch on the remote control box.
3. Remove the spark plug wire cover and all spark plugs, and then install the special service tools into a spark plug hole.



CAUTION:

Before removing the spark plugs, blow compressed air in the spark plug well to clear out any dirt or dust that may fall into the cylinder.

Compression gauge ①: YU-33223
Compression gauge extension ②: YB-06563

4. Fully open the throttle, crank the engine until the reading on the compression gauge stabilizes, and then check the compression pressure.

Minimum compression pressure (reference data):
860 kPa (8.6 kgf/cm^2, 124.7 psi)

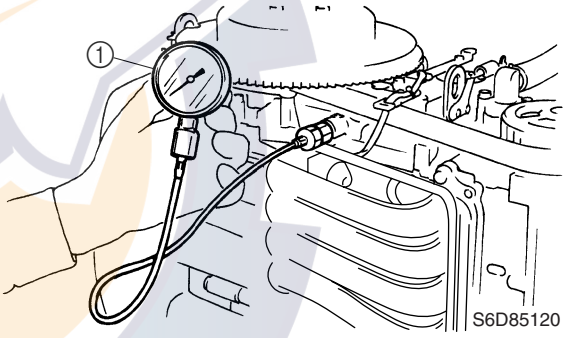
5. If the compression pressure is below specification and the compression pressure for each cylinder is unbalanced, add a small amount of engine oil to the cylinder, and then check the pressure again.

NOTE:

- If the compression pressure increases, check the pistons and piston rings for wear. Replace if necessary.
- If the compression pressure does not increase, check the valve clearance, valve, valve seat, cylinder head gasket, and cylinder head. Adjust or replace if necessary.

Checking the oil pressure

1. Remove the flywheel magnet cover.
2. Place a rag under the oil pressure switch.
3. Remove the oil pressure switch, and then install an oil pressure gauge ① to the oil pressure switch installation hole.



NOTE:

Use a general pressure gauge.

4. Start the engine and warm it up for 5 minutes.
5. Check the oil pressure. Check the oil pump, oil leakage, and oil strainer if below specification.

Oil pressure (reference data):
510 kPa (5.1 kgf/cm^2, 74.0 psi) at engine idle speed

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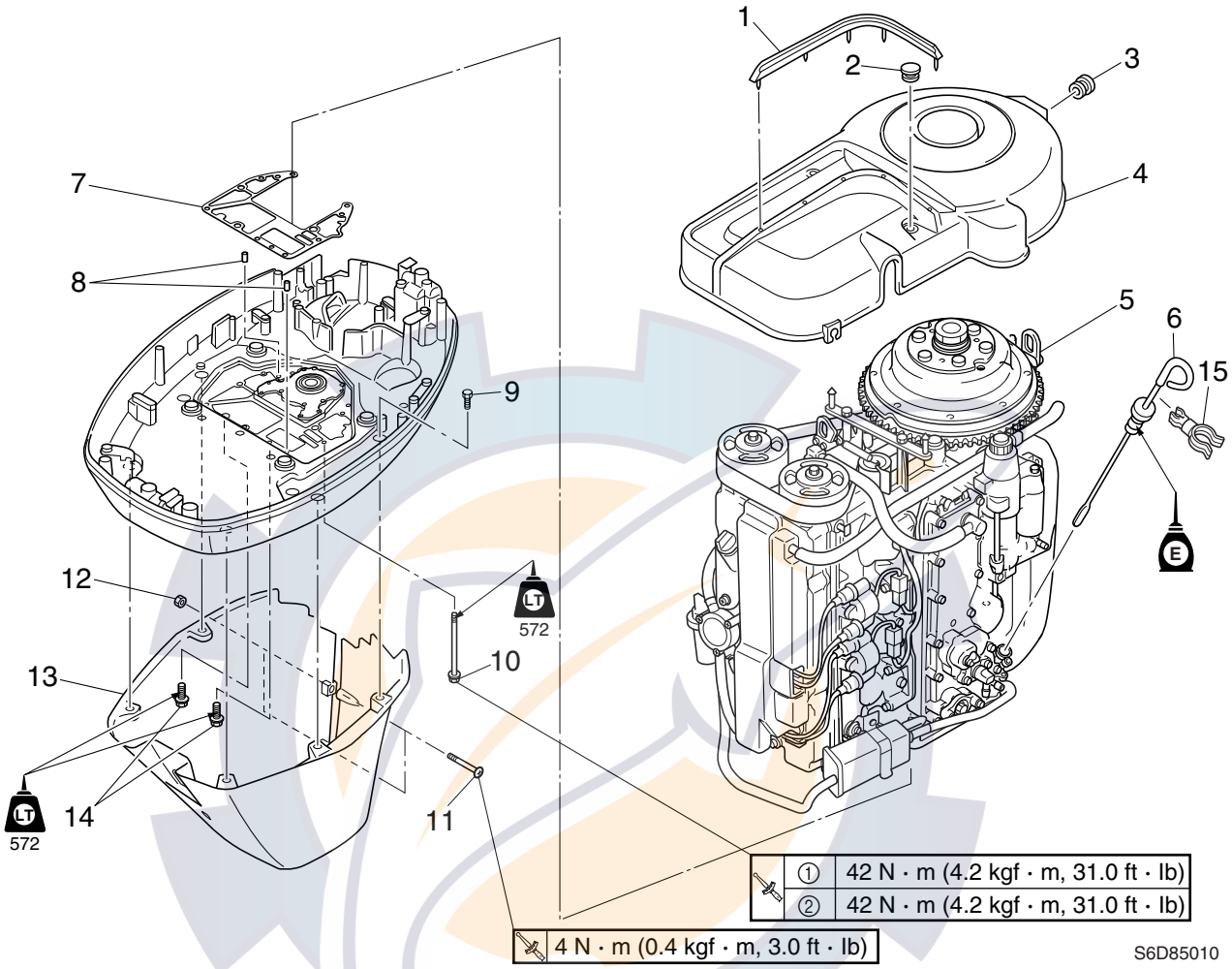

No.	Part name	Q'ty	Remarks
1	Damper	1	
2	Grommet	2	
3	Grommet	1	
4	Flywheel magnet cover	1	
5	Power unit	1	
6	Oil dipstick	1	
7	Gasket	1	**Not reusable**
8	Dowel	2	
9	Bolt	5	M6 × 16 mm
10	Bolt	6	M10 × 130 mm
11	Screw	2	ø6 × 40 mm
12	Nut	2	
13	Apron	1	
14	Bolt	2	M8 × 35 mm
15	Holder	1	

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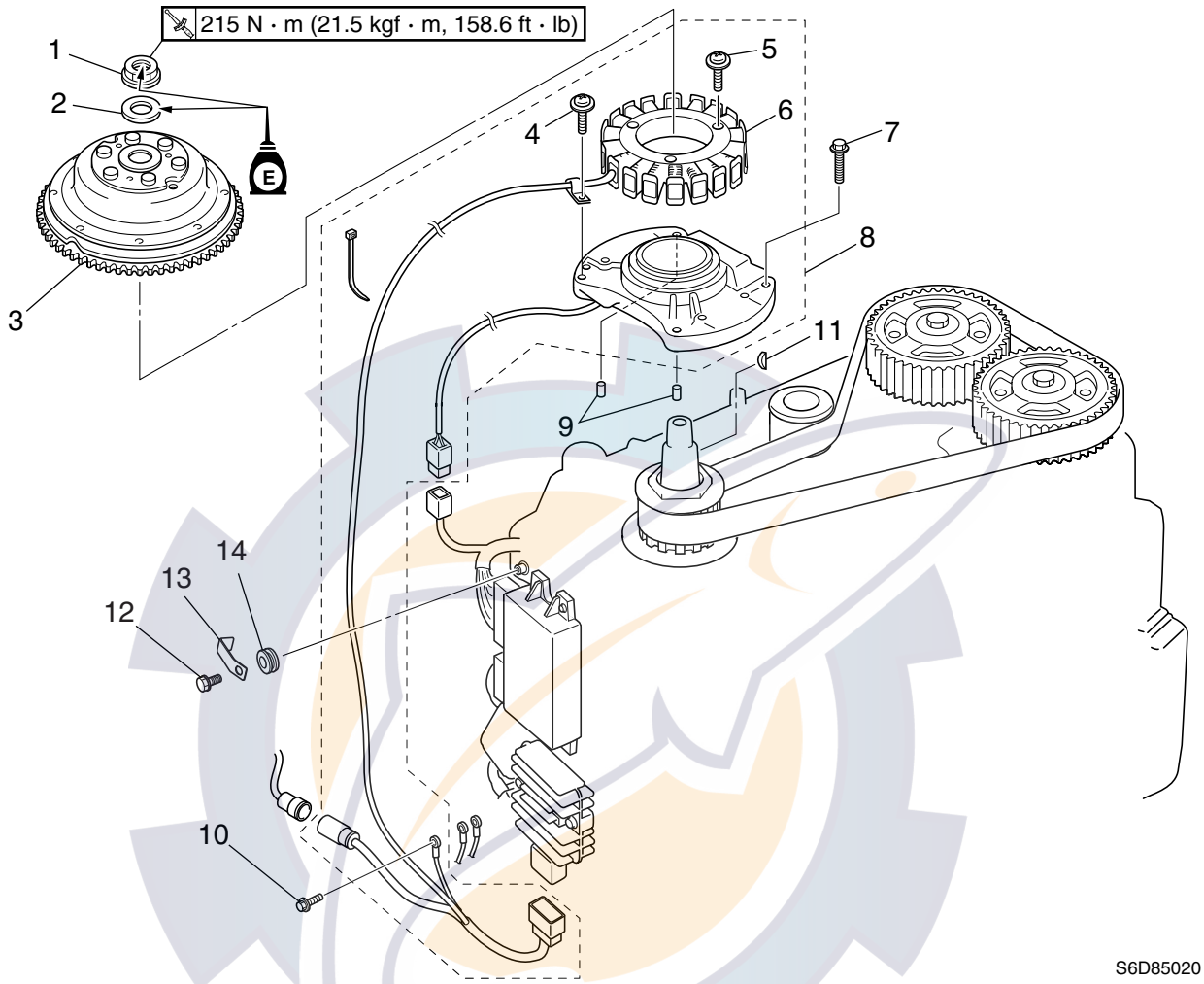

No.	Part name	Q'ty	Remarks
1	Nut	1	
2	Washer	1	
3	Flywheel magnet	1	
4	Screw	1	ø4 × 10 mm
5	Screw	3	ø6 × 30 mm
6	Stator coil	1	
7	Bolt	4	M6 × 30 mm
8	Stator assembly	1	
9	Collar	2	
10	Bolt	1	M6 × 15 mm
11	Woodruff key	1	
12	Bolt	1	M6 × 15 mm
13	Holder	1	
14	Grommet	1	

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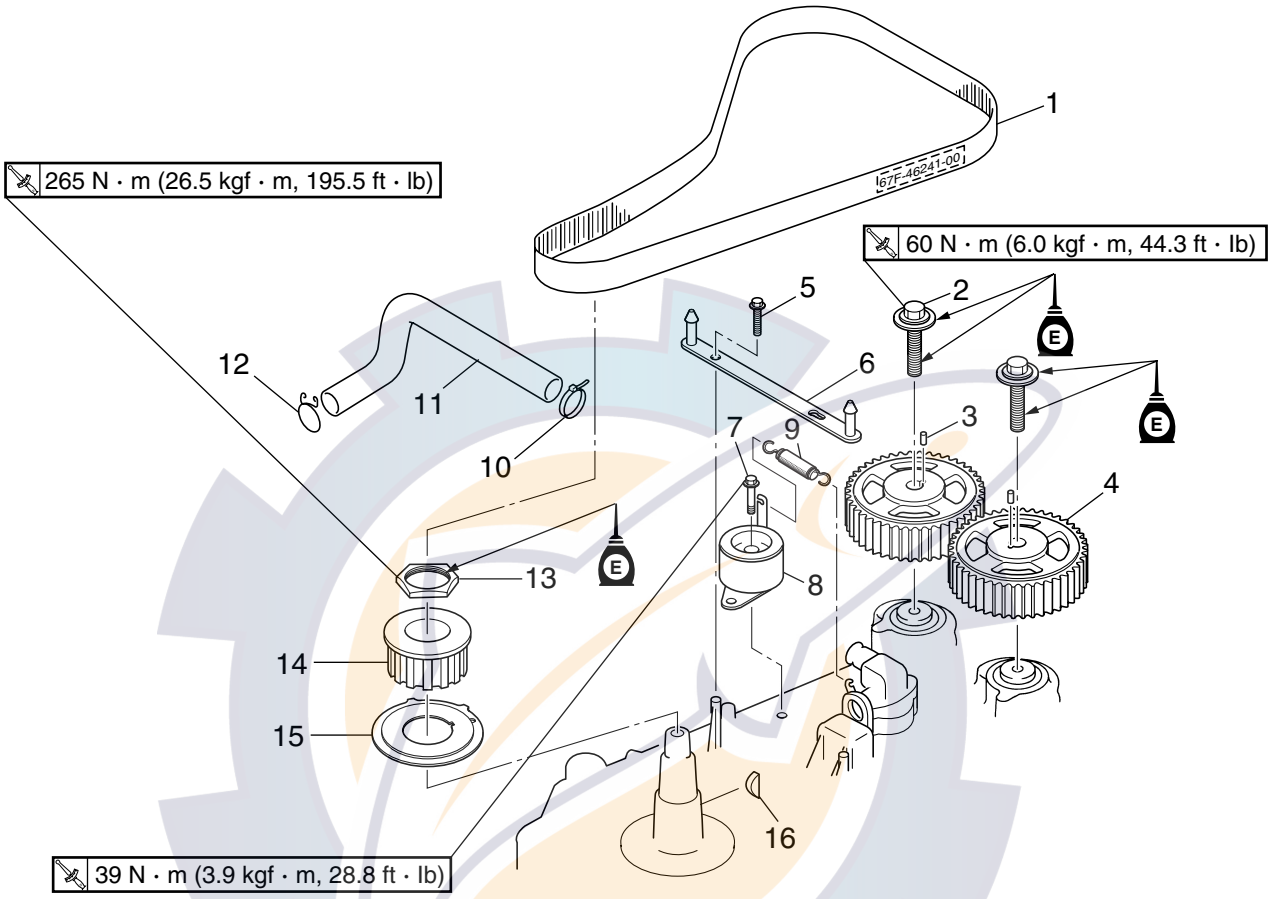

S6D85030

No.	Part name	Q'ty	Remarks
1	Timing belt	1	
2	Bolt	2	M10 × 35 mm
3	Dowel	2	
4	Driven sprocket	2	
5	Bolt	2	M6 × 15 mm
6	Bracket	1	
7	Bolt	1	M10 × 45 mm
8	Timing belt tensioner	1	
9	Spring	1	
10	Plastic tie	1	**Not reusable**
11	Hose	1	
12	Clamp	1	
13	Nut	1	
14	Drive sprocket	1	
15	Plate	1	
16	Woodruff key	1	

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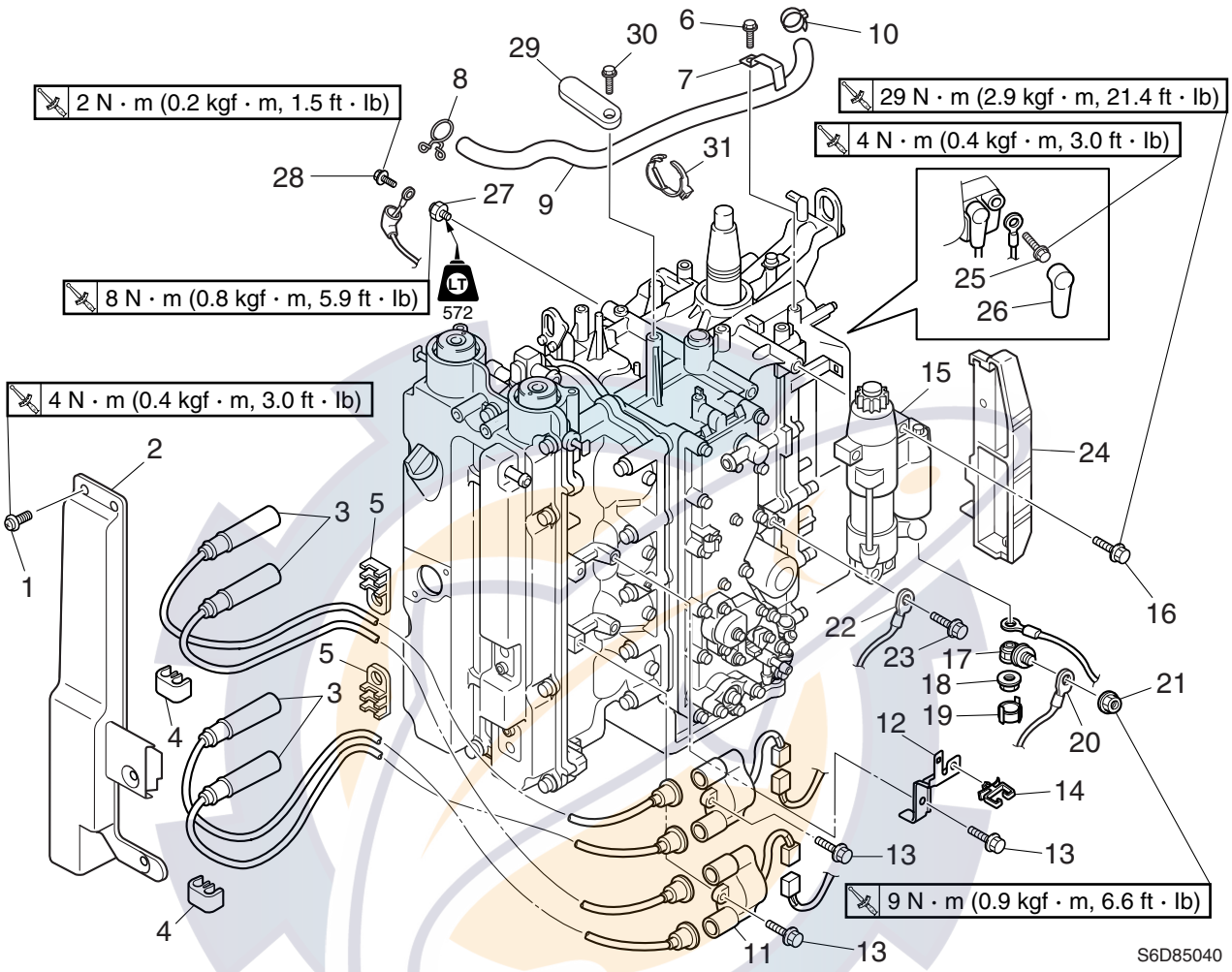
2 N · m (0.2 kgf · m, 1.5 ft · lb)
8 N · m (0.8 kgf · m, 5.9 ft · lb)
4 N · m (0.4 kgf · m, 3.0 ft · lb)
29 N · m (2.9 kgf · m, 21.4 ft · lb)
4 N · m (0.4 kgf · m, 3.0 ft · lb)
9 N · m (0.9 kgf · m, 6.6 ft · lb)
LT
572
S6D85040

No.	Part name	Q'ty	Remarks
1	Screw	5	ø6 × 30 mm
2	Cover	1	
3	Spark plug wire	4	
4	Holder	2	
5	Holder	2	
6	Bolt	1	M6 × 12 mm
7	Holder	1	
8	Clamp	1	
9	Hose	1	
10	Plastic tie	1	**Not reusable**
11	Ignition coil	2	
12	Bracket	2	
13	Bolt	4	M6 × 25 mm
14	Holder	2	
15	Starter motor	1	
16	Bolt	3	M8 × 45 mm
17	Terminal	1	

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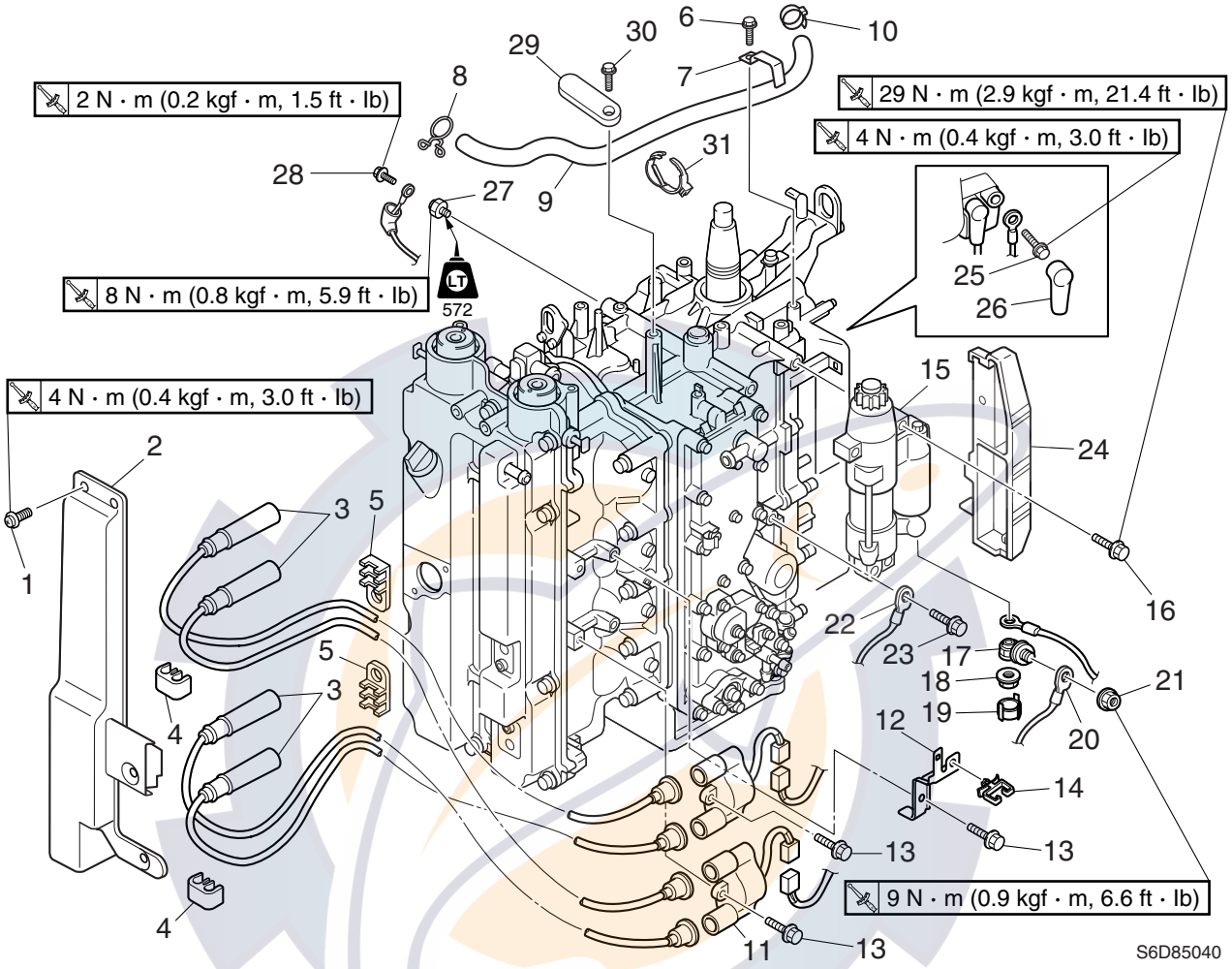
2 N · m (0.2 kgf · m, 1.5 ft · lb)
8 N · m (0.8 kgf · m, 5.9 ft · lb)
4 N · m (0.4 kgf · m, 3.0 ft · lb)
29 N · m (2.9 kgf · m, 21.4 ft · lb)
4 N · m (0.4 kgf · m, 3.0 ft · lb)
9 N · m (0.9 kgf · m, 6.6 ft · lb)
LT
572
S6D85040

No.	Part name	Q'ty	Remarks
18	Nut	1	
19	Cap	1	
20	Positive battery lead	1	
21	Nut	1	
22	Negative battery lead	1	
23	Bolt	1	M6 × 20 mm
24	Junction box cover	1	
25	Bolt	1	M6 × 10 mm
26	Cap	1	
27	Oil pressure switch	1	
28	Bolt	1	M4 × 8 mm
29	Holder	1	
30	Bolt	1	M6 × 25 mm
31	Clamp	1	

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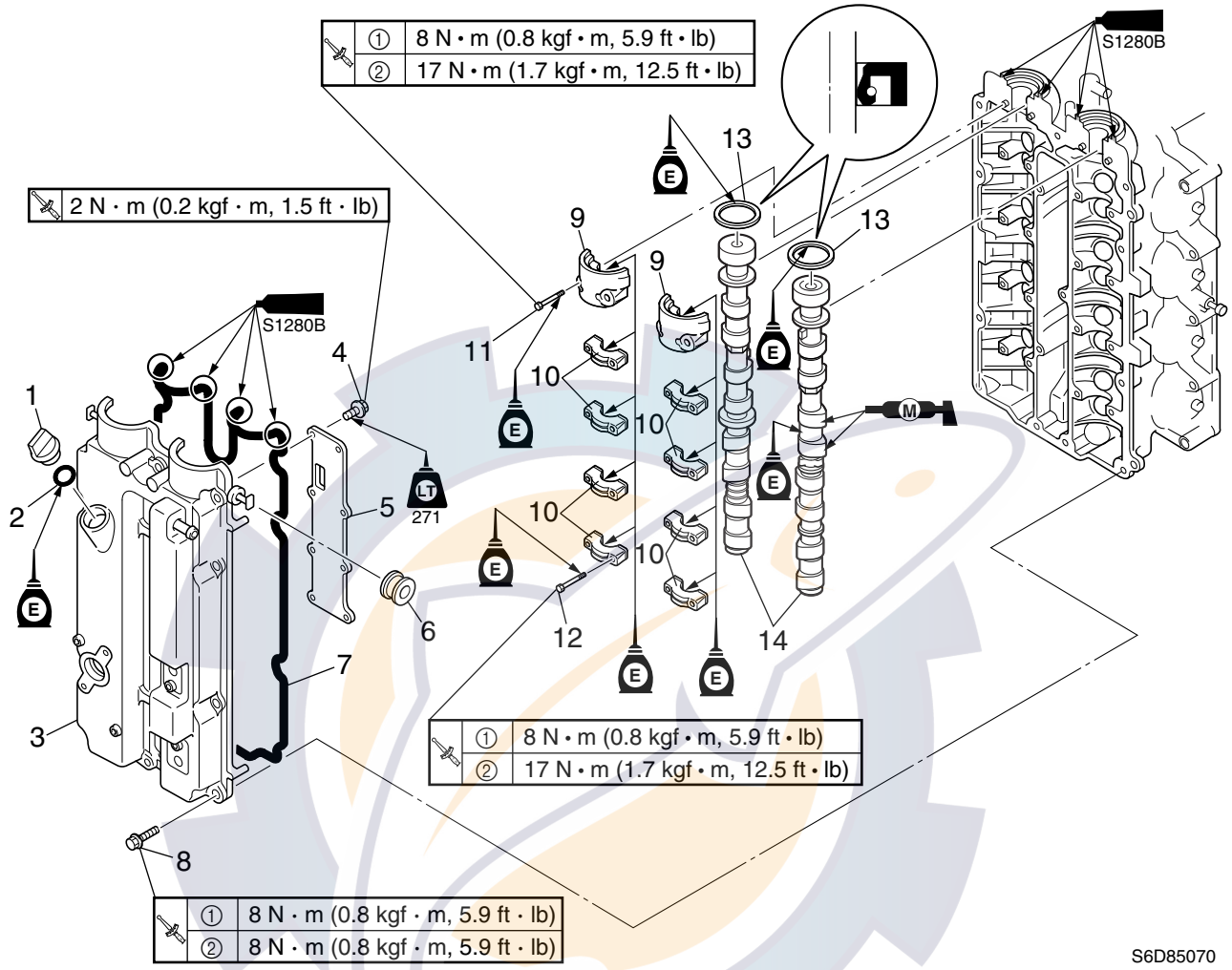
① 8 N • m (0.8 kgf • m, 5.9 ft • lb)
② 17 N • m (1.7 kgf • m, 12.5 ft • lb)
2 N • m (0.2 kgf • m, 1.5 ft • lb)
S1280B
S1280B
LT 271
M
① 8 N • m (0.8 kgf • m, 5.9 ft • lb)
② 17 N • m (1.7 kgf • m, 12.5 ft • lb)
① 8 N • m (0.8 kgf • m, 5.9 ft • lb)
② 8 N • m (0.8 kgf • m, 5.9 ft • lb)
S6D85070

No.	Part name	Q'ty	Remarks
1	Oil filler cap	1	
2	O-ring	1	
3	Cylinder head cover	1	
4	Screw	8	ø4 × 8 mm
5	Plate	1	
6	Grommet	2	
7	Gasket	1	**Not reusable**
8	Bolt	14	M6 × 30 mm
9	Camshaft cap	2	
10	Camshaft cap	8	
11	Bolt	4	M7 × 48 mm
12	Bolt	16	M7 × 37 mm
13	Oil seal	2	**Not reusable**
14	Camshaft	2	

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Checking the valve clearance

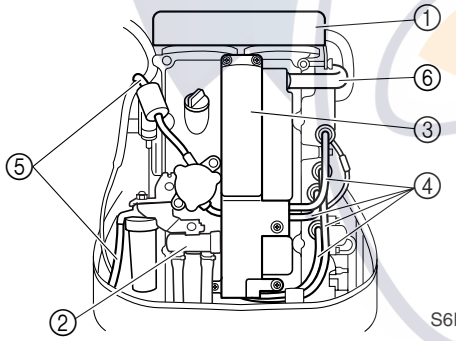
CAUTION:

- **Do not turn the flywheel magnet counterclockwise, otherwise the valve system may be damaged.**
- **Do not remove the ignition timing pointer.**
- **Do not turn the flywheel magnet or the driven sprockets when the timing belt is not installed. Otherwise the piston and valves will interfere with each other and be damaged.**

NOTE:

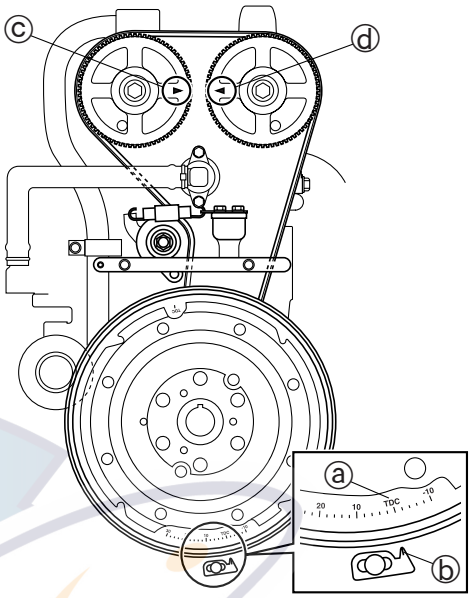
For removal and installation procedures of the timing belt, driven sprockets, and camshafts, see the applicable procedures in this manual.

1. Remove the flywheel magnet cover ①, filter ②, and spark plug wire cover ③, disconnect the spark plug wires ④, fuel hoses ⑤, and blowby hose ⑥, and then remove all spark plugs.



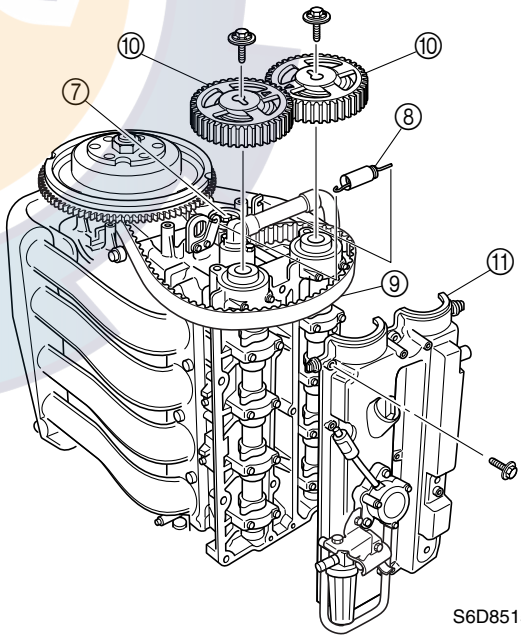
S6D85130

2. Turn the flywheel magnet clockwise and align the "TDC" mark ⓐ on the flywheel magnet with the pointer ⓑ, and check that "▲" marks ⓒ and ⓓ on the driven sprockets are aligned.



S6D85140

3. Loosen the tensioner bolt ⑦, and then remove the spring ⑧, timing belt ⑨, driven sprockets ⑩, and cylinder head cover ⑪.



S6D85150

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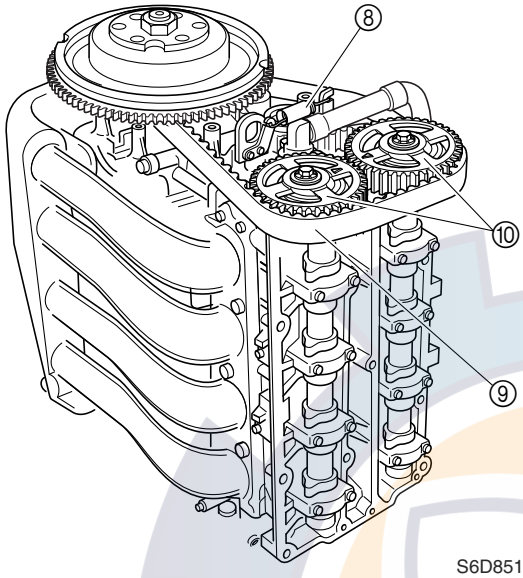
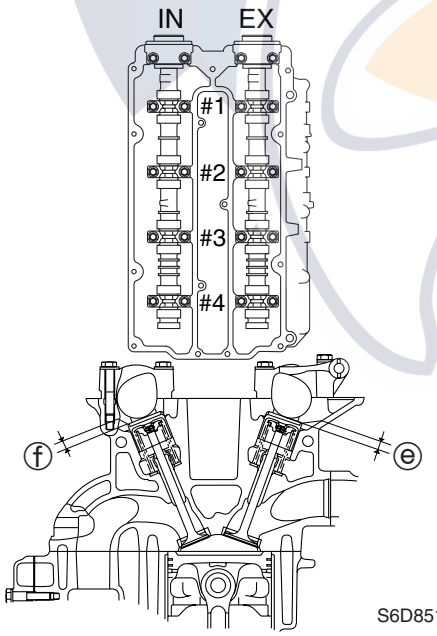
4. Install the driven sprockets ⑩, timing belt ⑨, and spring ⑧, and then tighten the tensioner bolt.



S6D85160

5. Check the intake valve clearance for cylinders #1 and #2, and the exhaust valve clearance for cylinders #1 and #3. Adjust if out of specification.



S6D85170

NOTE:
- Check the valve clearance when the engine is cold.
- Note the measurement.

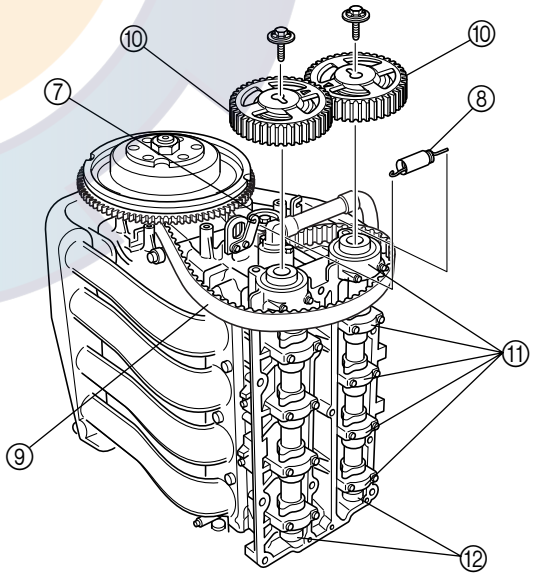
Valve clearance (cold):
Intake ⓔ:
0.20 ± 0.03 mm (0.008 ± 0.001 in)
Exhaust ⓕ:
0.34 ± 0.03 mm (0.013 ± 0.001 in)

6. Turn the flywheel magnet 360° clockwise.

7. Check the intake valve clearance for cylinders #3 and #4, and the exhaust valve clearance for cylinders #2 and #4. Adjust if out of specification.

8. Turn the flywheel magnet clockwise and align the "TDC" mark on the flywheel magnet with the pointer, and check that the "▲" marks on the driven sprockets are aligned.

9. Loosen the tensioner bolt ⑦, and then remove the spring ⑧, timing belt ⑨, driven sprockets ⑩, camshaft caps ⑪, and camshafts ⑫.



S6D85180

NOTE:
Do not mix the valve train parts. Keep them organized in their proper groups.

10. Remove the valve lifters from the cylinder head.

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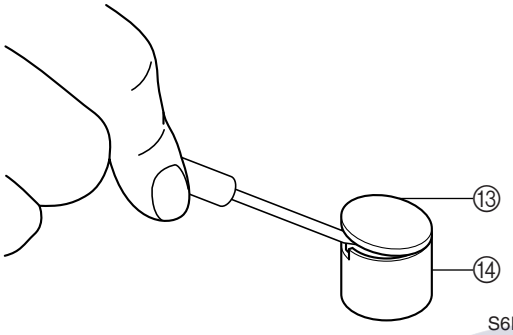
11. Remove the valve shim ⑬ from the valve lifter ⑭ using a thin screwdriver.



S6D85190

12. Measure the valve shim thickness with a micrometer, and then note the measurement.

13. Select the necessary valve shim by calculating its thickness with the following formula.

Necessary valve shim thickness = Removed valve shim thickness + Measured valve clearance – Specified valve clearance

Example:
If the “Removed valve shim thickness” is 2.10 mm, the “Measured valve clearance” is 0.30 mm and the “Specified valve clearance” is 0.20 mm, then the necessary valve shim thickness = 2.10 + 0.30 – 0.20 = 2.20 mm

14. Install the necessary valve shim into the valve lifter, and then install the valve lifters into the cylinder head.

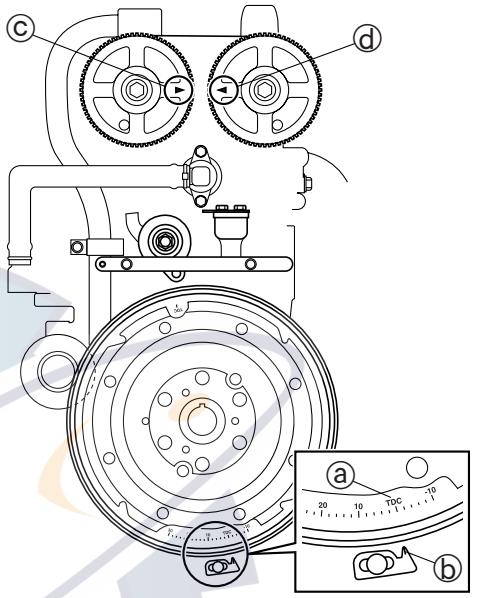
15. Install the camshafts, camshaft caps, driven sprockets, and timing belt, and then tighten the tensioner bolt.

16. Check the valve clearance. Adjust if necessary.

17. Loosen the tensioner bolt, and then remove the timing belt and driven sprockets.

18. Install the cylinder head cover and driven sprockets.

19. Check that the “TDC” mark ⓐ on the flywheel magnet is aligned with the pointer ⓑ, and that “▲” marks ⓒ and ⓓ on the driven sprockets are aligned.



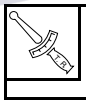
S6D85200

20. Install the timing belt.

21. Install the spark plugs, and then connect the spark plug wires, fuel hoses, and blowby hose.

	Spark plug: 25 N·m (2.5 kgf·m, 18.4 ft·lb)

22. Install the spark plug wire cover, filter, and flywheel magnet cover.

	Spark plug wire cover screw: 4 N·m (0.4 kgf·m, 3.0 ft·lb)

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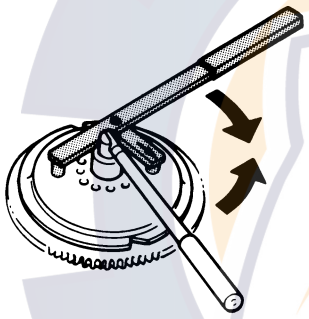
Replacing the timing belt

CAUTION:

- **Do not turn the drive sprocket counterclockwise, otherwise the valve system may be damaged.**
- **Do not remove the ignition timing pointer.**
- **Do not turn the drive sprocket or the driven sprockets when the timing belt is not installed. Otherwise the piston and valves will interfere with each other and be damaged.**

1. Remove the flywheel magnet cover.
2. Loosen the flywheel magnet nut.



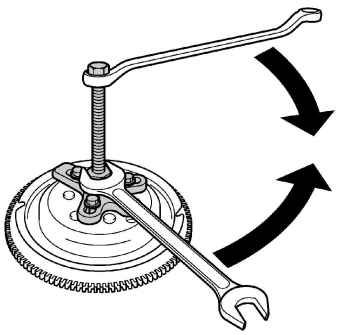
S63P5250

CAUTION:

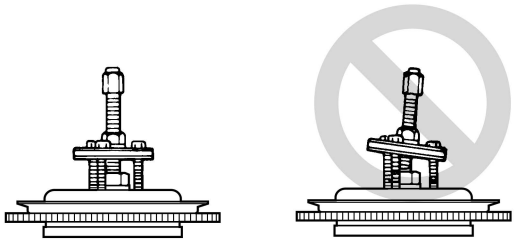
Apply force in the direction of the arrows shown to prevent the flywheel holder from slipping off easily.

	Flywheel magnet holder: YB-06139

3. Remove the flywheel magnet.



S63P5270



S69J5180

CAUTION:

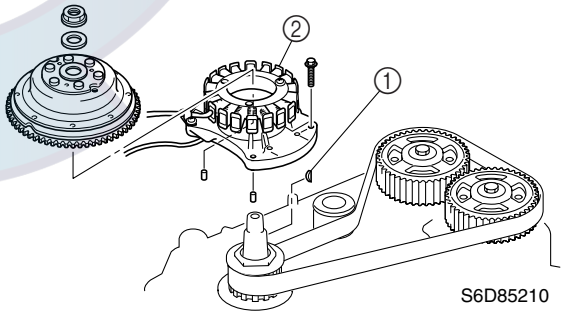
To prevent damage to the engine or tools, screw in the puller set bolts evenly and completely so that the puller plate is parallel to the flywheel magnet.

NOTE:

Apply force to the crankshaft end until the flywheel magnet comes off the tapered portion of the crankshaft.

	Universal puller: YB-06117

4. Remove the Woodruff key ① and stator assembly ②.



S6D85210

NOTE:

Do not loosen the pulser coil screw.

5. Turn the drive sprocket clockwise and align the hole ⓐ on the retaining plate with the projection ⓑ on the cylinder block, and check that "▲" marks ⓒ and ⓓ on the driven sprockets are aligned.

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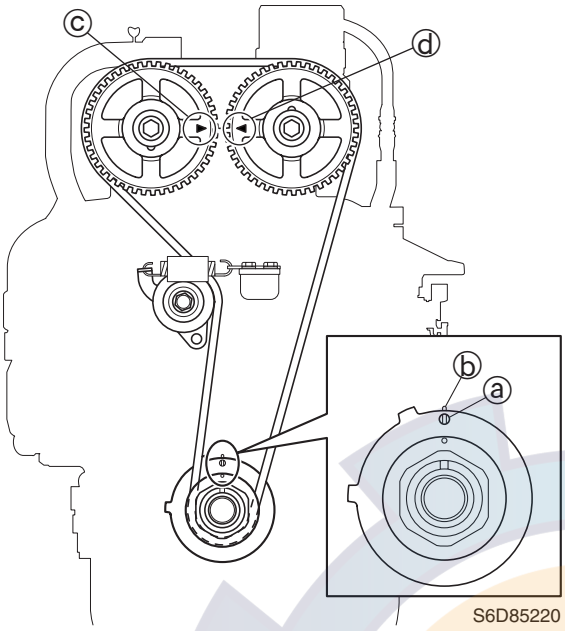
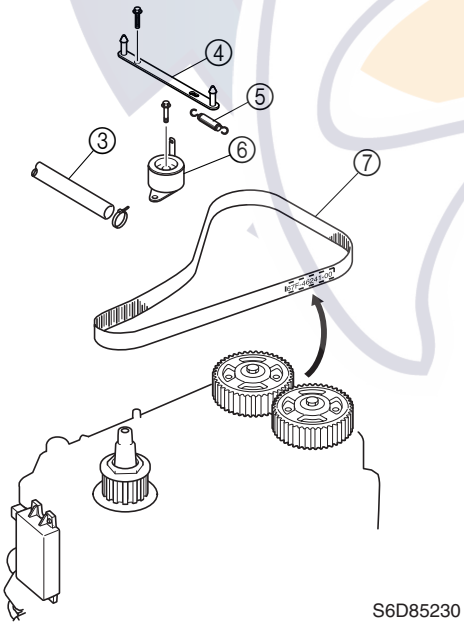


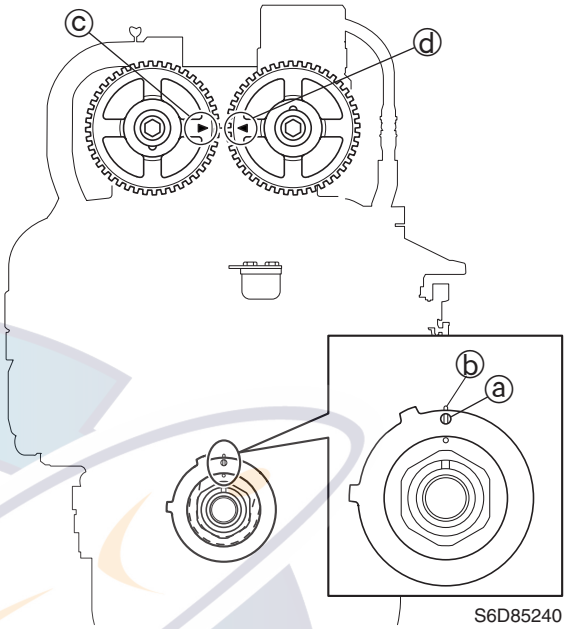
6. Disconnect the cooling water hose ③ and remove the bracket ④.

7. Remove the spring ⑤ and timing belt tensioner ⑥, and then remove the timing belt ⑦ from the driven sprockets, then from the drive sprocket.



8. Check that the hole ⓐ on the retaining plate and the projection ⓑ on the cylinder block are aligned.

9. Check that "▲" marks ⓒ and ⓓ on the driven sprockets are aligned.



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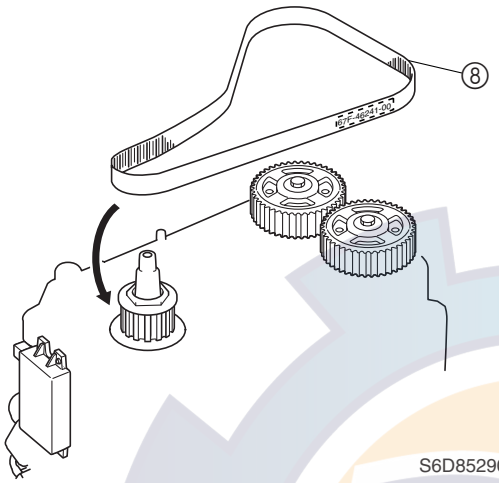
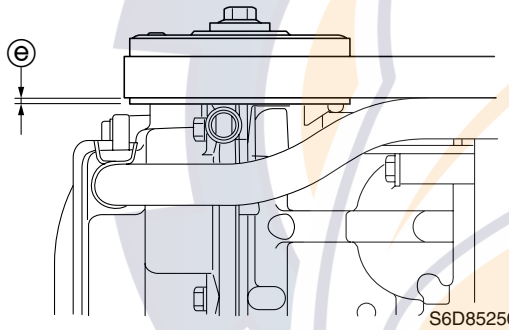
10. Install a new timing belt ⑧ onto the drive sprocket with its part number in the upright position, and then install the belt onto the driven sprockets by turning it counterclockwise.



S6D85290



S6D85250

CAUTION:

- **Do not twist, turn inside out, or bend the timing belt beyond the maximum limit of 25 mm (1.0 in) otherwise it can be damaged.**
- **Do not get oil or grease on the timing belt.**

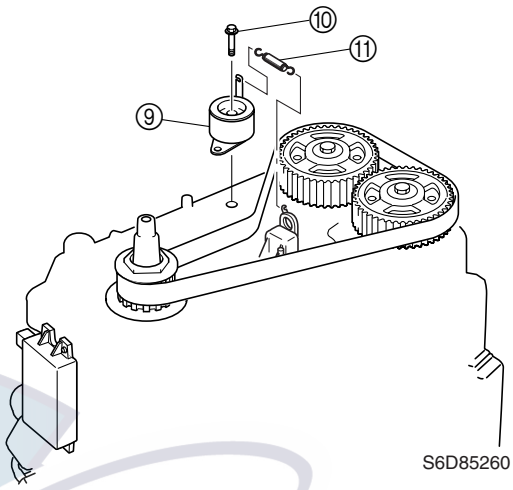
NOTE:

The lower edge of the timing belt should be 2 mm (0.08 in) ⓔ from the bottom of the driven sprockets.

11. Install the timing belt tensioner ⑨ and finger tighten the bolt ⑩ until the bolt seat contacts the timing belt tensioner.

12. Loosen the timing belt tensioner bolt 90°.

13. Install the spring ⑪.



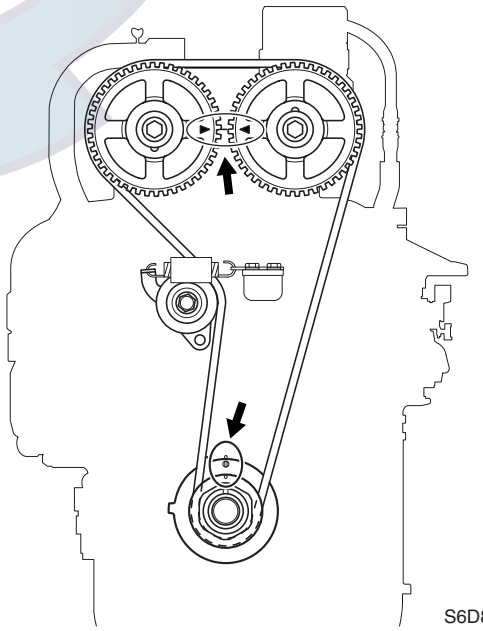
S6D85260

14. Take up the timing belt slack by turning the drive sprocket clockwise at least two full turns.

15. Tighten the timing belt tensioner bolt to the specified torque.

	Timing belt tensioner bolt: 39 N·m (3.9 kgf·m, 28.8 ft·lb)

16. Turn the drive sprocket two full turns, and then check that the alignment marks are aligned.


S6D85280

17. Install the bracket and connect the cooling water hose.

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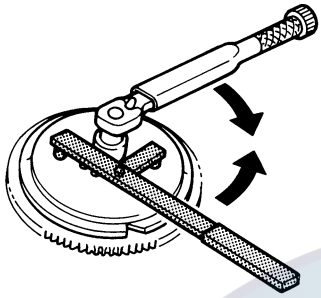
18. Install the stator assembly and Woodruff key.

19. Install the flywheel magnet.



S63P5360

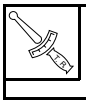
CAUTION:

Apply force in the direction of the arrows shown to prevent the flywheel holder from slipping off easily.

NOTE:

Apply engine oil to the flywheel magnet nut before installation.

	Flywheel magnet holder: YB-06139

	Flywheel magnet nut: 215 N·m (21.5 kgf·m, 158.6 ft·lb)

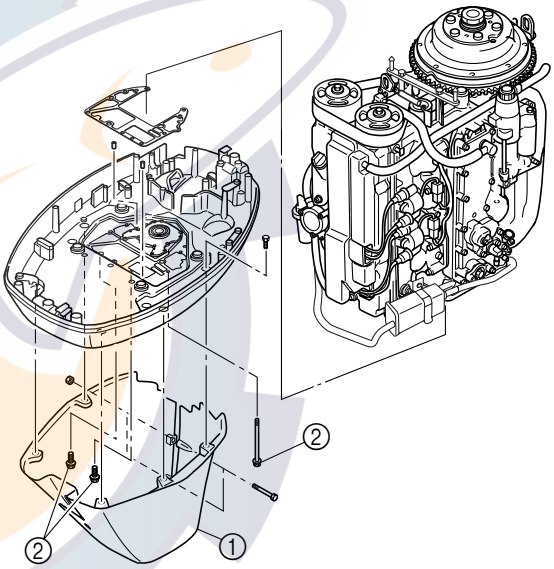
20. Install the flywheel magnet cover.

Removing the power unit

NOTE:

It is recommended to loosen the flywheel magnet nut before removing the power unit to improve working efficiency.

1. Remove the flywheel magnet cover.
2. Disconnect the battery leads and trim sensor coupler.
3. Remove the junction box cover, and then disconnect the PTT motor leads and PTT switch coupler.
4. Disconnect the throttle cable and shift cable.
5. Disconnect the fuel hose and shift position switch coupler.
6. Disconnect the cooling water pilot hose, canister hose, and flushing hose.
7. Remove the oil dipstick.
8. Remove the apron ①, and then remove the power unit by removing the bolts ②.



S6D85350

9. Remove the flywheel magnet.

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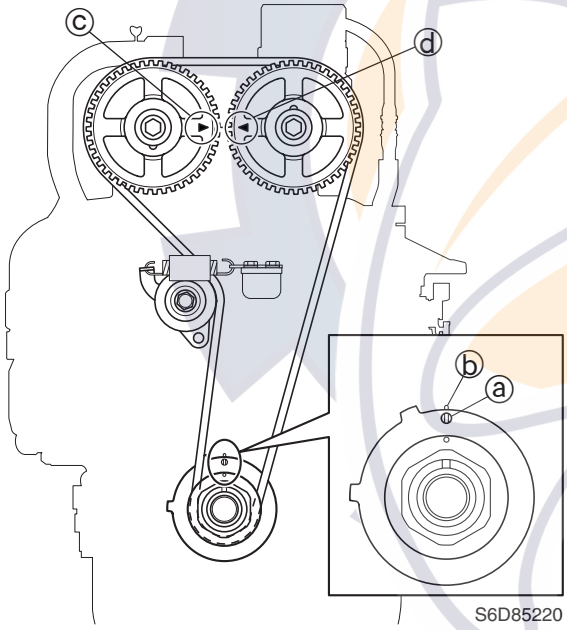
Removing the timing belt and sprockets

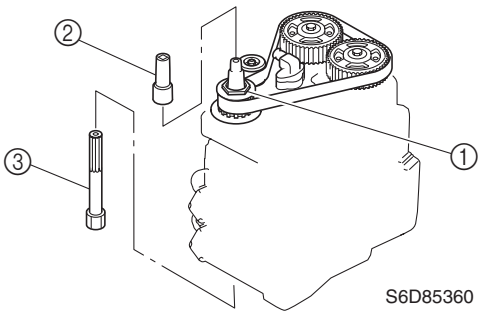
CAUTION:

- **Do not turn the drive sprocket counter-clockwise, otherwise the valve system may be damaged.**
- **Do not turn the drive sprocket or the driven sprockets when the timing belt is not installed. Otherwise the piston and valves will interfere with each other and be damaged.**

1. Turn the drive sprocket clockwise and align the hole ⓐ on the retaining plate with the projection ⓑ on the cylinder block, and check that "▲" marks ⓒ and ⓓ on the driven sprockets are aligned.



2. Loosen the drive sprocket nut ①.

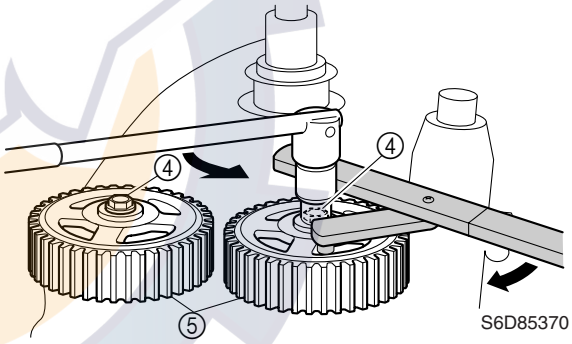


NOTE:

- Use a deep socket ② for this procedure.
- Do not turn the camshaft when loosening the drive sprocket nut.

	Crankshaft holder ③: YB-06552

3. Disconnect the cooling water hose and remove the bracket.
4. Remove the spring and timing belt tensioner, and then remove the timing belt from the driven sprockets, then from the drive sprocket.
5. Loosen the driven sprocket bolts ④, and then remove the driven sprockets ⑤.



NOTE:

Do not turn the camshafts when loosening the driven sprocket bolts.

	Flywheel magnet holder: YB-06139

6. Remove the nut ①, drive sprocket ⑥, retaining plate ⑦, and Woodruff key ⑧.

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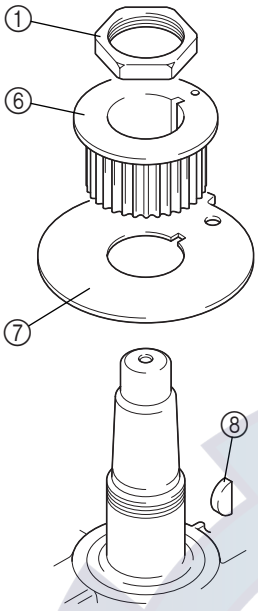


S6D85380

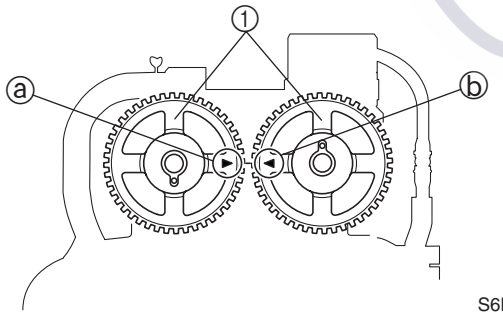
Checking the timing belt and sprockets

1. Check the interior and exterior of the timing belt for cracks, damage, or wear. Replace if necessary.

2. Check the drive sprocket and driven sprockets for cracks, damage, or wear. Replace if necessary.

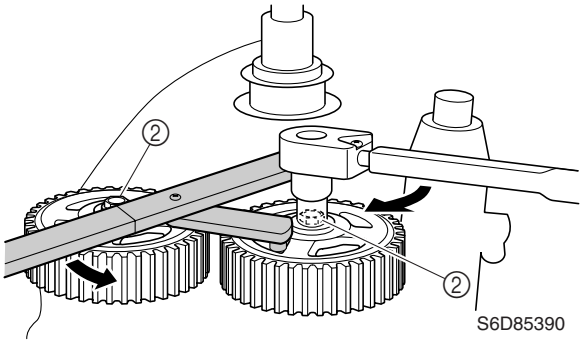
Installing the sprockets and timing belt

1. Install the dowels and driven sprockets ①, and check that "▲" marks ⓐ and ⓑ on the driven sprockets are aligned.



S6D85660

2. Tighten the driven sprocket bolts ② to the specified torque.



S6D85390

NOTE:
- Apply engine oil to the driven sprocket bolts before installation.
- Do not turn the camshafts when tightening the driven sprocket bolts.

	Flywheel magnet holder: YB-06139
	Driven sprocket bolt ②: 60 N·m (6.0 kgf·m, 44.3 ft·lb)

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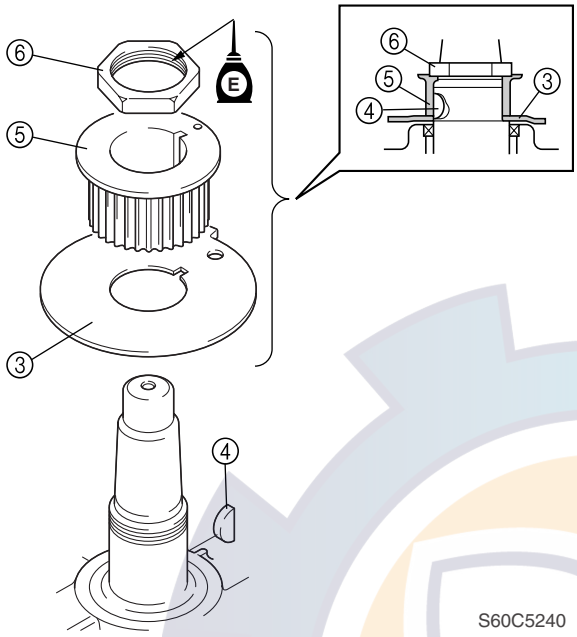
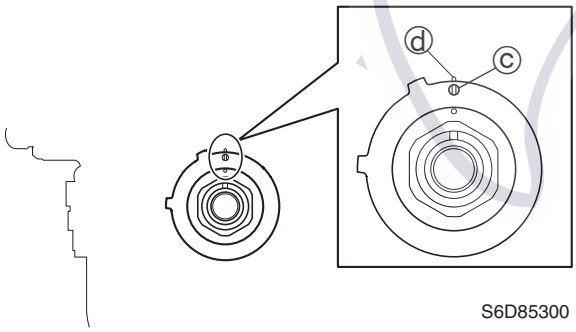
3. Install the retaining plate ③, Woodruff key ④, drive sprocket ⑤, and nut ⑥, and then tighten the nut.



S60C5240

NOTE:
- Apply engine oil to the drive sprocket nut before installation.
- Tighten the drive sprocket nut finger tight.

4. Check that the hole ⓒ on the retaining plate is aligned with the projection ⓓ on the cylinder block.

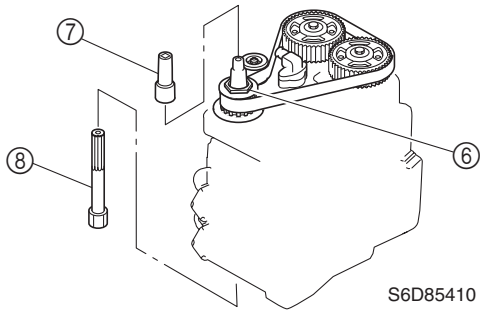


S6D85300

5. Install the timing belt and timing belt tensioner.

NOTE:
For timing belt installation procedure, see "Replacing the timing belt."

6. Tighten the drive sprocket nut ⑥ to the specified torque.



S6D85410

NOTE:
Use a deep socket ⑦ for this procedure.

	Crankshaft holder ⑧: YB-06552
	Drive sprocket nut ⑥: 265 N·m (26.5 kgf·m, 195.5 ft·lb)

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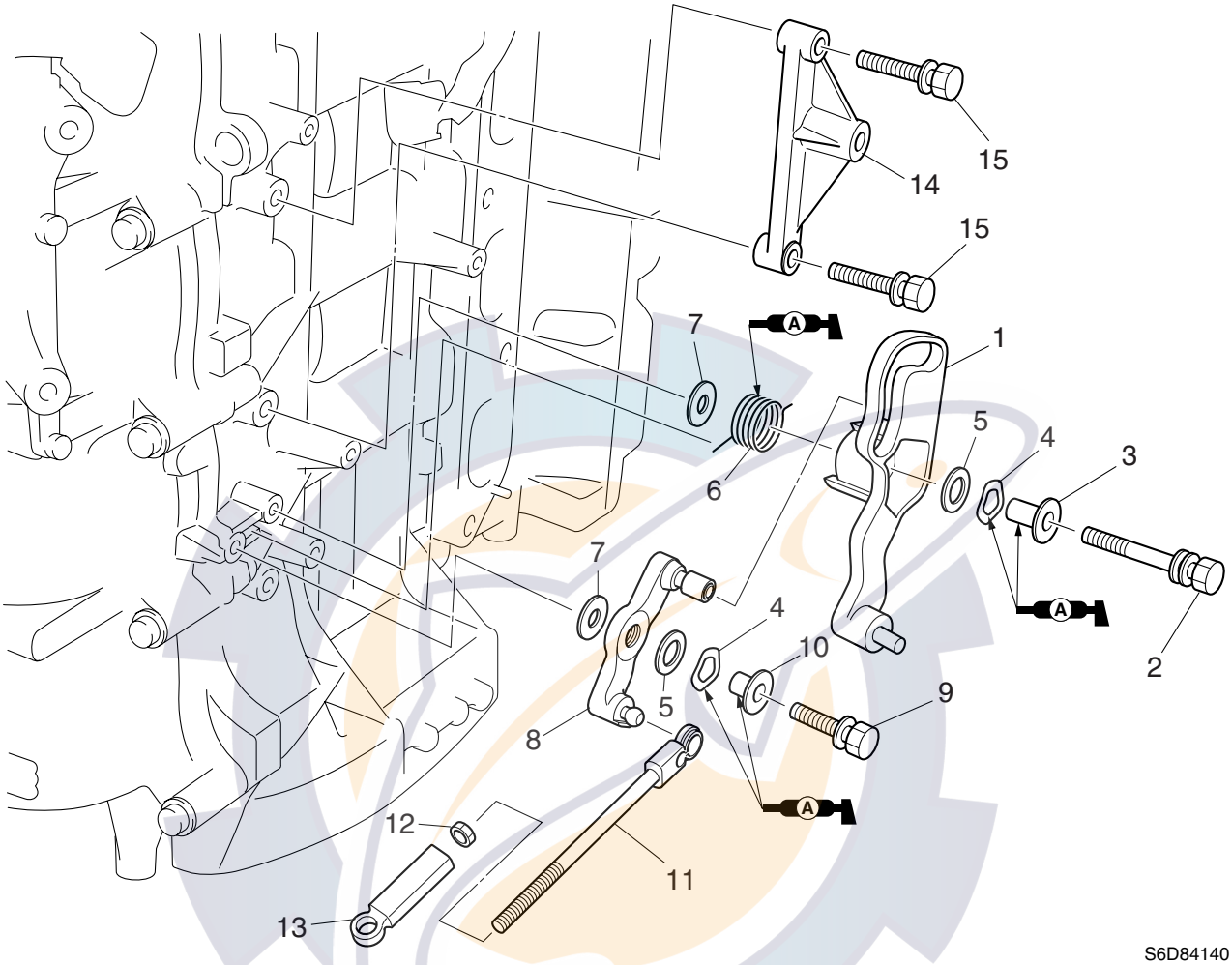
Throttle link



No.	Part name	Q'ty	Remarks
1	Throttle cam	1	
2	Bolt	1	M6 × 35 mm
3	Collar	1	
4	Wave washer	2	
5	Washer	2	
6	Spring	1	
7	Washer	2	
8	Throttle lever	1	
9	Bolt	1	M6 × 25 mm
10	Collar	1	
11	Throttle link rod	1	
12	Nut	1	
13	Throttle link rod joint	1	
14	Bracket	1	
15	Bolt	2	M6 × 30 mm

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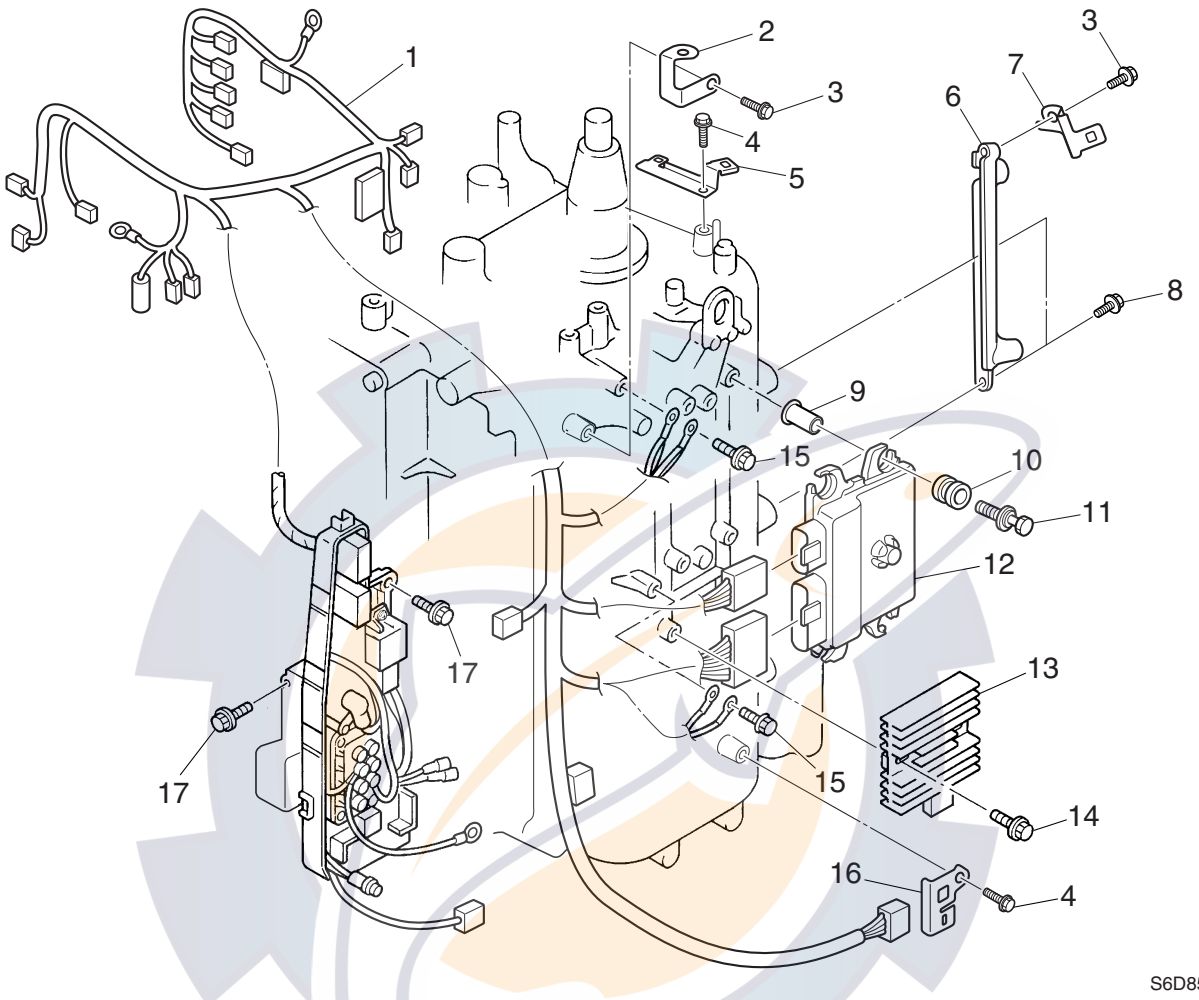
ECM



No.	Part name	Q'ty	Remarks
1	Wiring harness	1	
2	Bracket	1	
3	Bolt	2	M6 × 15 mm
4	Bolt	2	M6 × 12 mm
5	Bracket	1	
6	Bracket	1	
7	Bracket	1	
8	Bolt	2	M6 × 20 mm
9	Collar	4	
10	Grommet	4	
11	Bolt	4	M6 × 30 mm
12	ECM	1	
13	Rectifier Regulator	1	
14	Bolt	2	M6 × 25 mm
15	Bolt	2	M6 × 20 mm
16	Bracket	1	
17	Bolt	5	M6 × 30 mm

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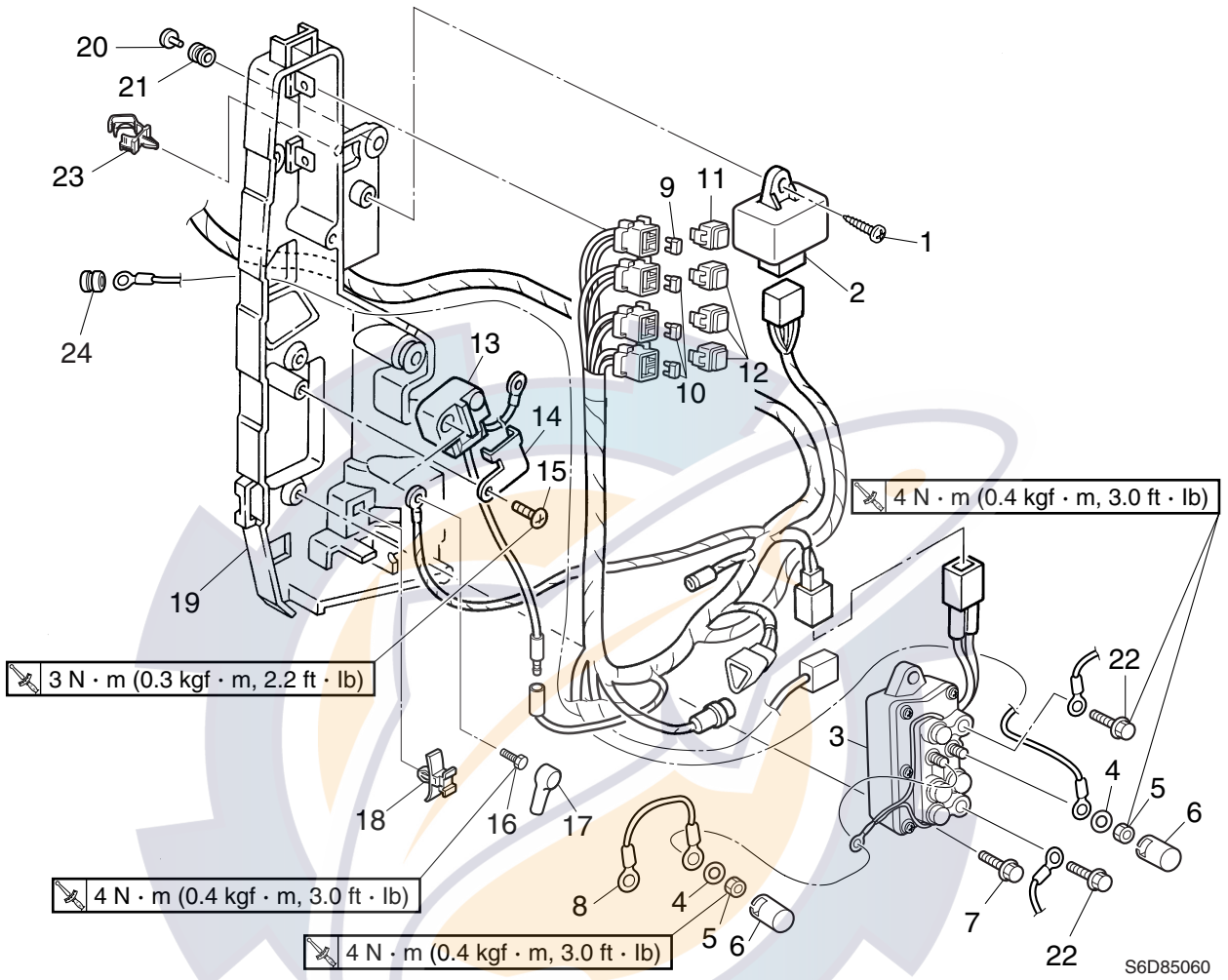
Junction box



No.	Part name	Q'ty	Remarks
1	Screw	1	ø6 × 25 mm
2	Main and fuel pump relay	1	
3	Power trim and tilt relay	1	
4	Washer	2	
5	Nut	2	
6	Cap	2	
7	Bolt	2	M6 × 20 mm
8	Ground lead	1	
9	Fuse	1	30 A
10	Fuse	3	20 A
11	Cap	1	
12	Cap	3	
13	Starter relay	1	
14	Holder	1	
15	Screw	1	ø6 × 20 mm
16	Bolt	1	M6 × 10 mm
17	Cap	1	

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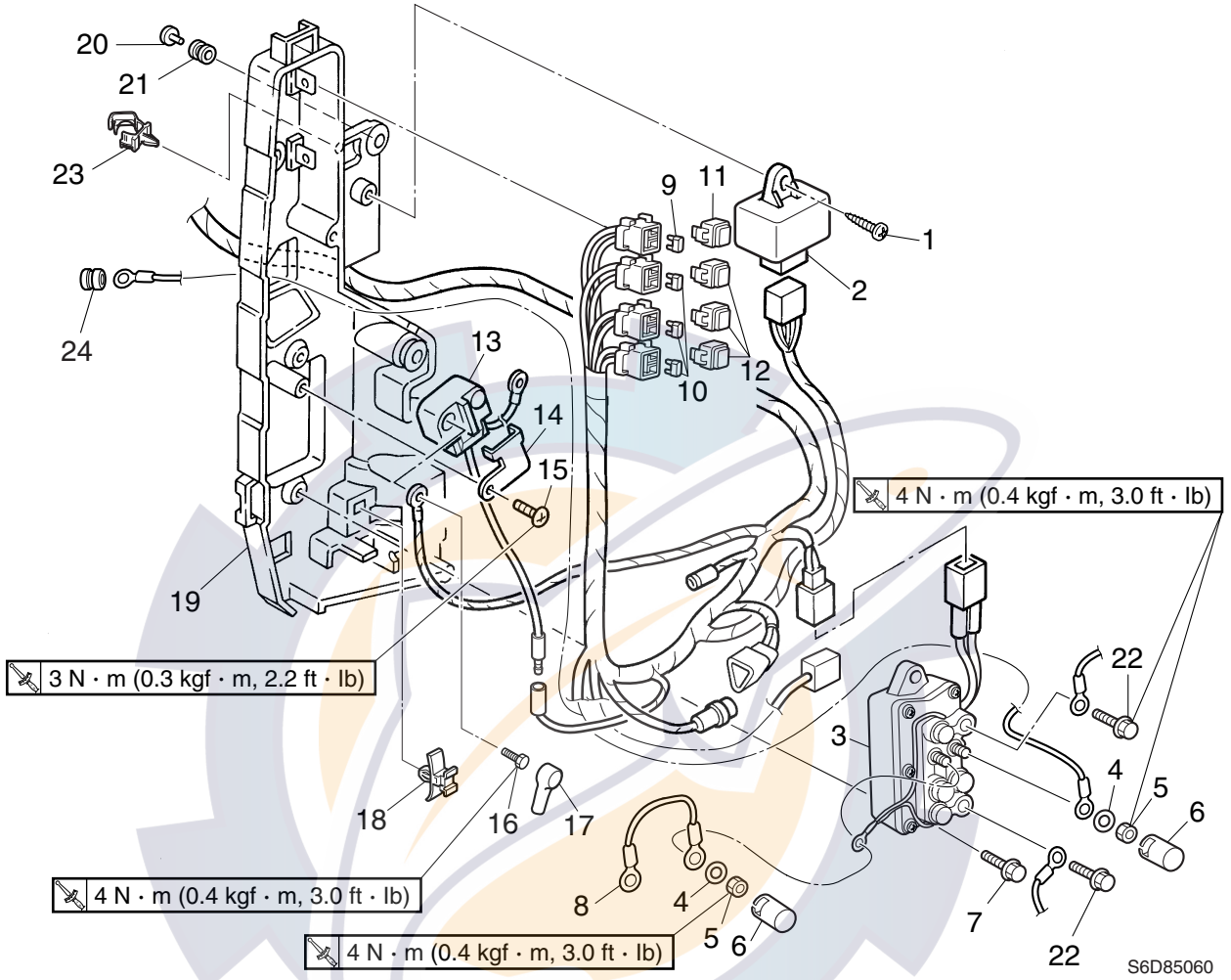

No.	Part name	Q'ty	Remarks
18	Holder	1	
19	Junction box	1	
20	Collar	5	
21	Grommet	5	
22	Bolt	2	M6 × 10 mm
23	Clamp	1	
24	Grommet	1	

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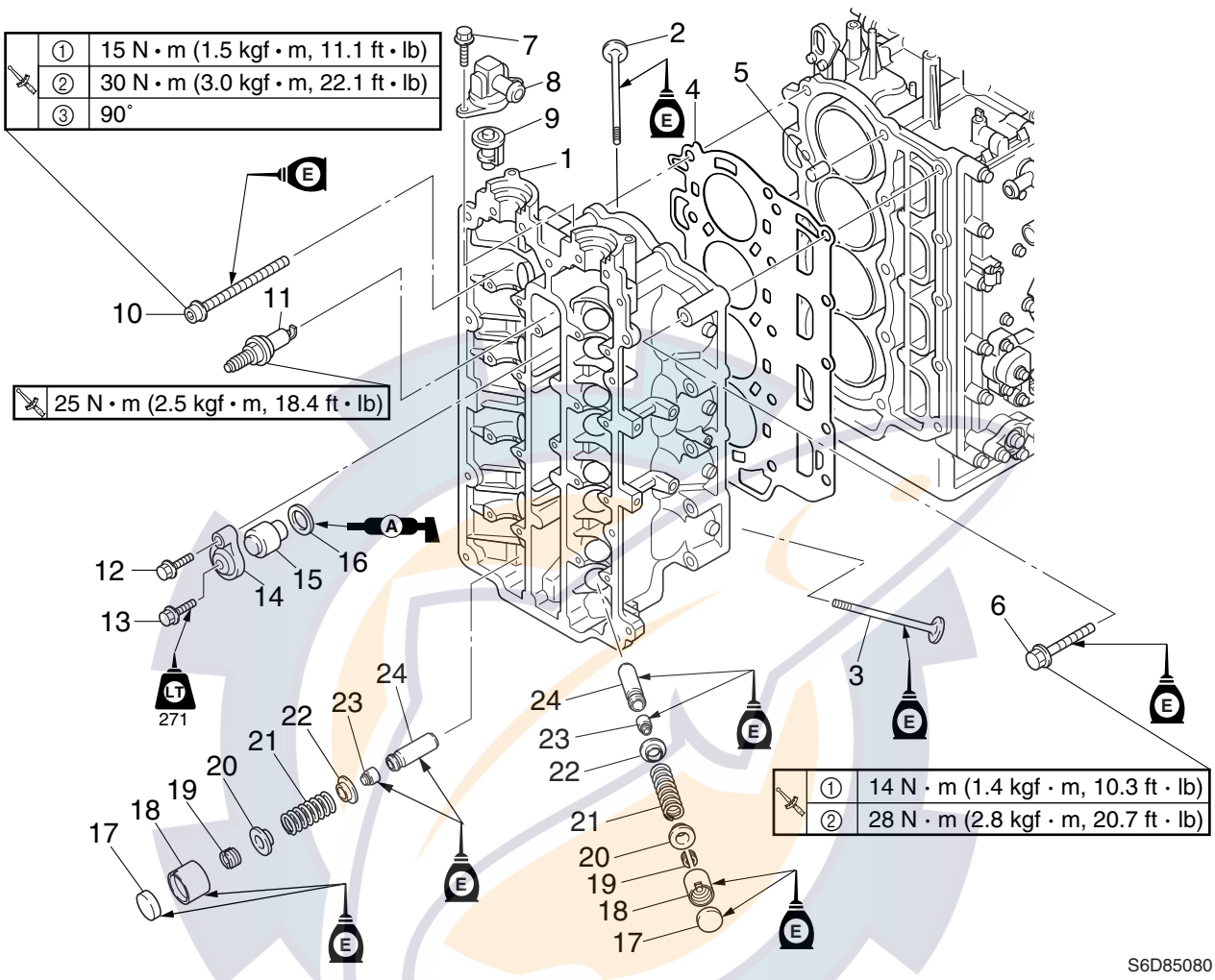
Cylinder head


① 15 N • m (1.5 kgf • m, 11.1 ft • lb)
② 30 N • m (3.0 kgf • m, 22.1 ft • lb)
③ 90°
25 N • m (2.5 kgf • m, 18.4 ft • lb)
① 14 N · m (1.4 kgf · m, 10.3 ft · lb)
② 28 N · m (2.8 kgf · m, 20.7 ft · lb)
271
S6D85080

No.	Part name	Q'ty	Remarks
1	Cylinder head	1	
2	Exhaust valve	8	
3	Intake valve	8	
4	Gasket	1	**Not reusable**
5	Collar	2	
6	Bolt	5	M8 × 55 mm
7	Bolt	2	M6 × 25 mm
8	Cover	1	
9	Thermostat	1	
10	Bolt	10	M10 × 143 mm
11	Spark plug	4	
12	Bolt	2	M8 × 40 mm
13	Bolt	2	M6 × 22 mm
14	Anode cover	2	
15	Anode	2	
16	Grommet	2	
17	Valve shim	16	

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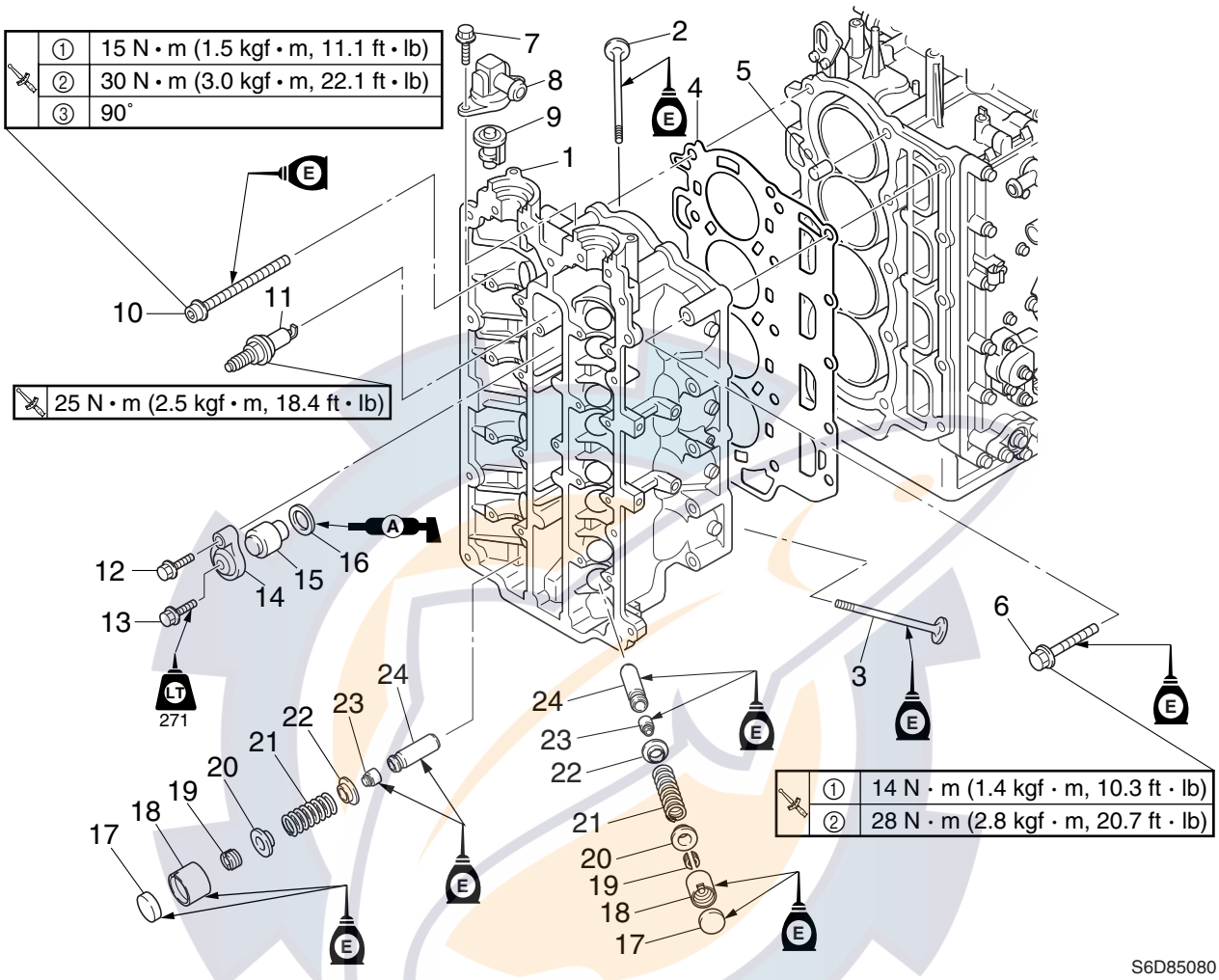
① 15 N • m (1.5 kgf • m, 11.1 ft • lb)
② 30 N • m (3.0 kgf • m, 22.1 ft • lb)
③ 90°
25 N • m (2.5 kgf • m, 18.4 ft • lb)
① 14 N · m (1.4 kgf · m, 10.3 ft · lb)
② 28 N · m (2.8 kgf · m, 20.7 ft · lb)
271
S6D85080

No.	Part name	Q'ty	Remarks
18	Valve lifter	16	
19	Valve cotter	32	
20	Valve spring retainer	16	
21	Valve spring	16	
22	Valve spring seat	16	
23	Valve seal	16	**Not reusable**
24	Valve guide	16	**Not reusable**

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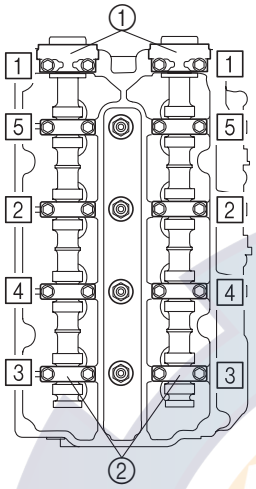
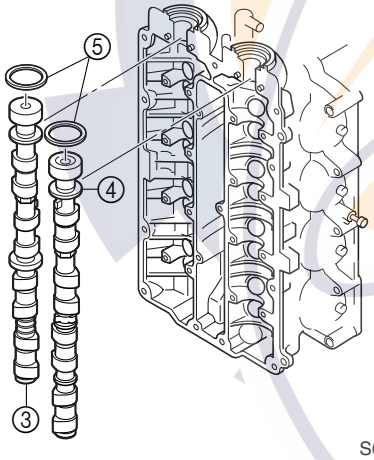
Removing the cylinder head

1. Remove the cylinder head cover.
2. Remove camshaft caps ① and ② in the sequence shown.



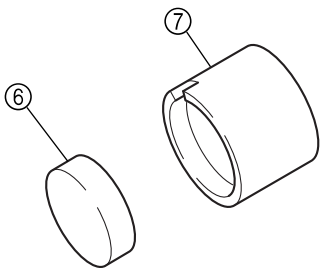
S6D85420

3. Remove the camshaft (intake) ③, camshaft (exhaust) ④, and oil seals ⑤.



S6D85430

4. Remove the valve shims ⑥ from the valve lifters ⑦.

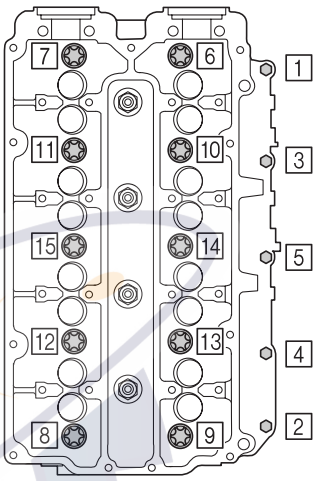


S60C5380

NOTE:

Do not mix the valve train parts. Keep them organized in their proper groups.

5. Remove the cylinder head bolts in the sequence shown.



S6D85440

CAUTION:

Do not scratch or damage the mating surfaces of the cylinder head and cylinder block.

5

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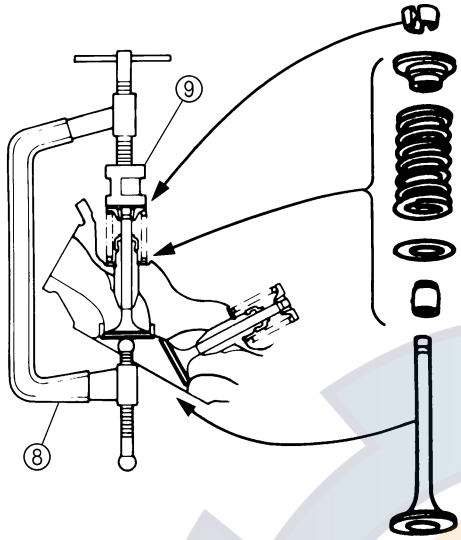
6. Remove the intake and exhaust valves.



S60C5390

NOTE:
Be sure to keep the valves, springs, and other parts in the order as they were removed.

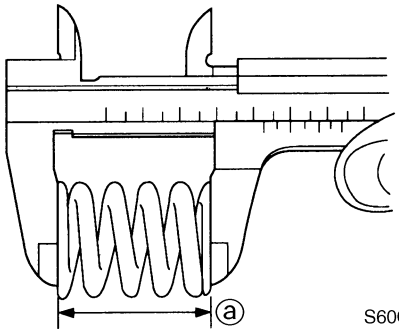
Valve spring compressor ⑧:
YM-01253
Valve spring compressor attachment ⑨:
YB-06320

Checking the valve lifters

1. Check the valve lifters for damage, scratches, or wear. Replace if necessary.

Checking the valve springs

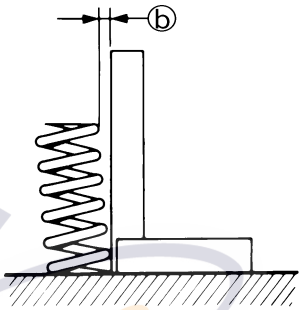
1. Measure the valve spring free length ⓐ. Replace if below specification.



S60C5400

Valve spring free length ⓐ:
53.20 mm (2.0945 in)

2. Measure the valve spring tilt ⓑ. Replace if above specification.



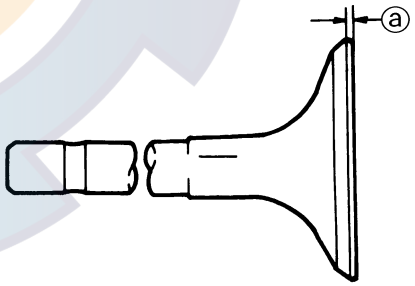
S60C5410

Valve spring tilt limit ⓑ:
2.6 mm (0.10 in)

Checking the valves

1. Check the valve face for pitting or wear. Replace if necessary.

2. Measure the valve margin thickness ⓐ. Replace if out of specification.



S60C5420

Valve margin thickness ⓐ:
Intake:
0.80–1.20 mm
(0.0315–0.0472 in)
Exhaust:
1.00–1.40 mm
(0.0394–0.0551 in)

3. Measure the valve stem diameter ⓑ. Replace if out of specification.

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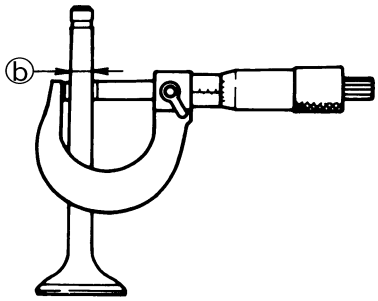
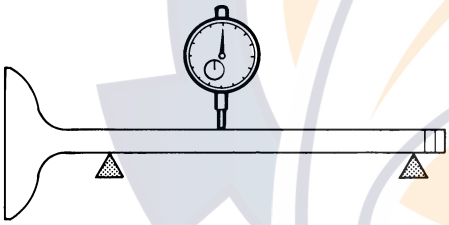


S60C5430

Valve stem diameter ⓑ:
Intake:
5.975–5.990 mm
(0.2352–0.2358 in)
Exhaust:
5.960–5.975 mm
(0.2346–0.2352 in)

4. Measure the valve stem runout. Replace if above specification.



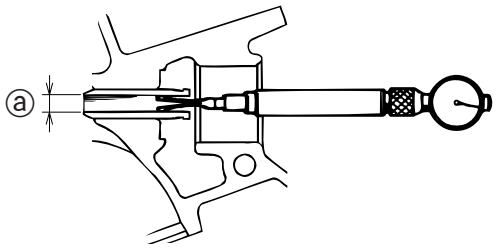
S60C5440

Valve stem runout limit:
0.01 mm (0.0004 in)

Checking the valve guides

NOTE:
Before checking the valve guide make sure that the valve stem diameter is within specification.

1. Measure the valve guide inside diameter ⓐ.



S60C5450

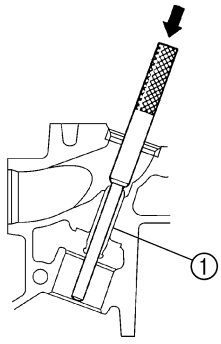
Valve guide inside diameter ⓐ:
Intake and exhaust:
6.000–6.018 mm
(0.2362–0.2369 in)

2. Calculate the valve stem-to-valve guide clearance as follows. Replace the valve guide if out of specification.

Valve stem-to-valve guide clearance = valve guide inside diameter – valve stem diameter:
Intake:
0.010–0.043 mm
(0.0004–0.0017 in)
Exhaust:
0.025–0.058 mm
(0.0010–0.0023 in)

Replacing the valve guides

1. Remove the valve guide ① by striking the special service tool from the combustion chamber side.



S60C5470

Valve guide remover/installer:
YM-04064-A

5

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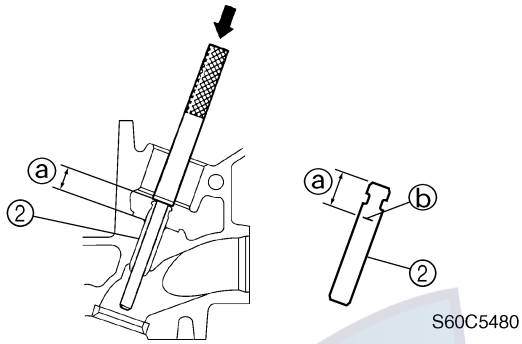
2. Install the new valve guide ② by striking the special tool from the camshaft side to the specified position ⓐ.



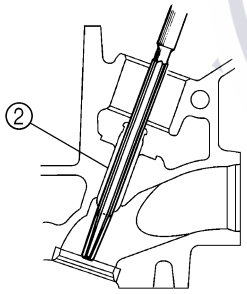
S60C5480

NOTE:
- Before installing the valve guide, mark its installation position ⓑ as shown.
- Apply engine oil to the surface of the new valve guide.

Valve guide remover/installer: YM-04064-A

Valve guide position ⓐ: 11.5 ± 0.2 mm (0.45 ± 0.01 in)

3. Insert the special service tool into the valve guide ②, and then ream the valve guide.



S60C5490

NOTE:
- Turn the valve guide reamer clockwise to ream the valve guide.
- Do not turn the reamer counterclockwise when removing the reamer.

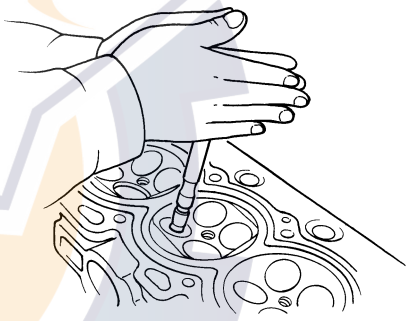
Valve guide reamer: YM-04066

4. Measure the valve guide inside diameter.

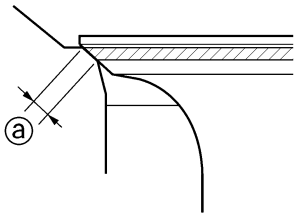
Valve guide inside diameter:
Intake and exhaust:
6.000–6.018 mm
(0.2362–0.2369 in)

Checking the valve seat

1. Eliminate carbon deposits from the valve with a scraper.
2. Apply a thin, even layer of Mechanic's blueing dye (Dykem) onto the valve seat.
3. Lap the valve slowly on the valve seat with a valve lapper (commercially available) as shown.


S69J5820

4. Measure the valve seat contact width ⓐ where the blueing dye is adhered to the valve face. Reface the valve seat if the valve is not seated properly or if the valve seat contact width is out of specification. Replace the valve guide if the valve seat contact is uneven.



S69J5830

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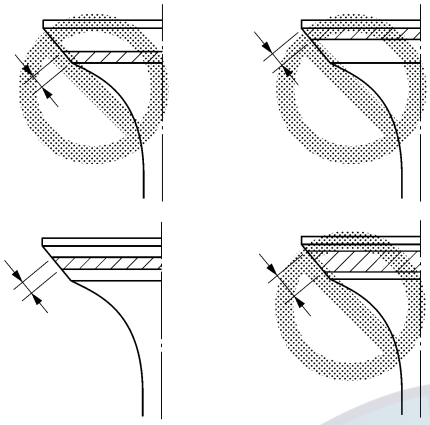
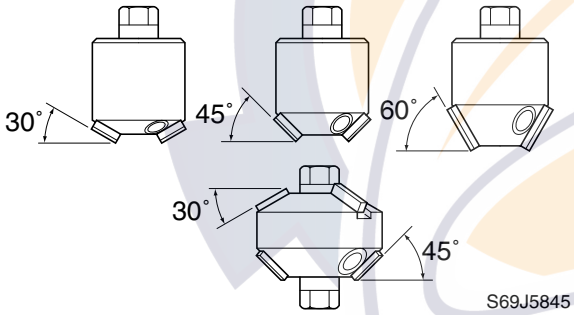


S69J5840

Valve seat contact width ⓐ:
1.20–1.60 mm (0.0472–0.0630 in)

Refacing the valve seat

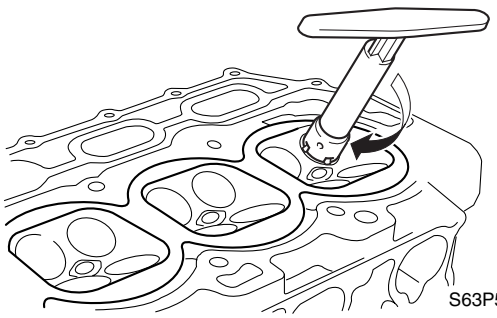
1. Reface the valve seat with the valve seat cutters.



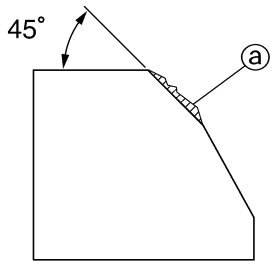
S69J5845

Neway valve seat kit: YB-91044

2. Cut the surface of the valve seat with a 45° cutter by turning the cutter clockwise until the valve seat face has become smooth.



S63P5230



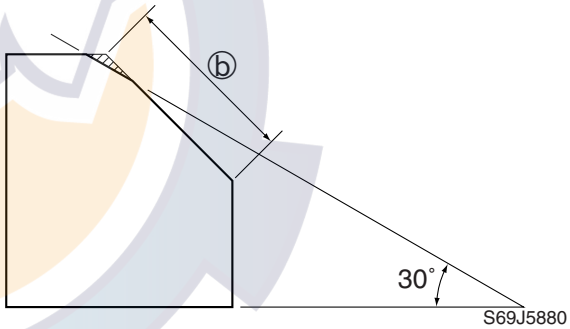
S69J5870

ⓐ Slag or rough surface

CAUTION:

Do not over cut the valve seat. Be sure to turn the cutter evenly downward at a pressure of 40–50 N (4–5 kgf, 8.8–11 lbf) to prevent chatter marks.

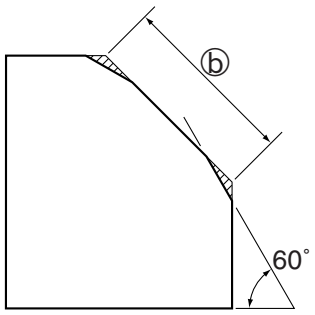
3. Use a 30° cutter to adjust the contact width of the top edge of the valve seat.



S69J5880

ⓑ Previous contact width

4. Use a 60° cutter to adjust the contact width of the bottom edge of the valve seat.



S69J5890

ⓑ Previous contact width

5

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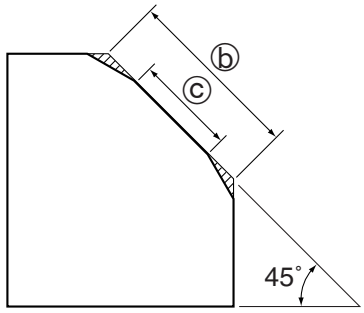
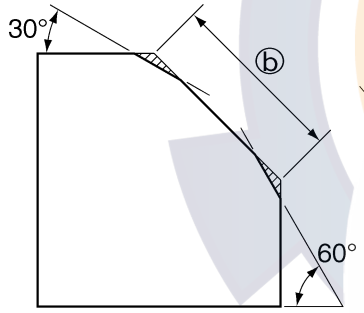
5. Use a 45° cutter to adjust the contact width of the valve seat to specification.



S69J5900

ⓑ Previous contact width
ⓒ Specified contact width

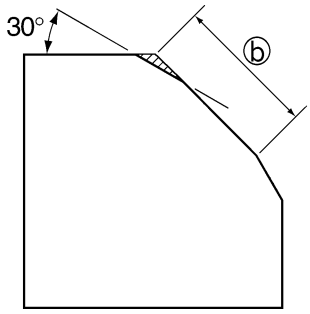
6. If the valve seat contact area is too wide and situated in the center of the valve face, use a 30° cutter to cut the top edge of the valve seat, a 60° cutter to cut the bottom edge to center the area and set its width.



S69J5910

ⓑ Previous contact width

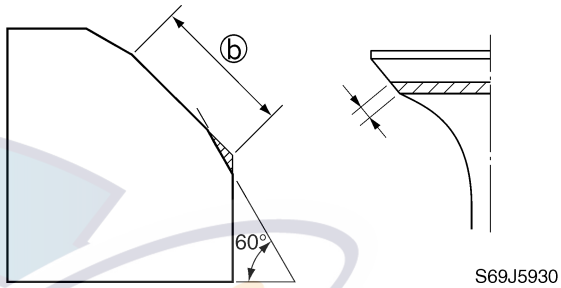
7. If the valve seat contact area is too narrow and situated near the top edge of the valve face, use a 30° cutter to cut the top edge of the valve seat. If necessary, use a 45° cutter to center the area and set its width.



S69J5920

ⓑ Previous contact width

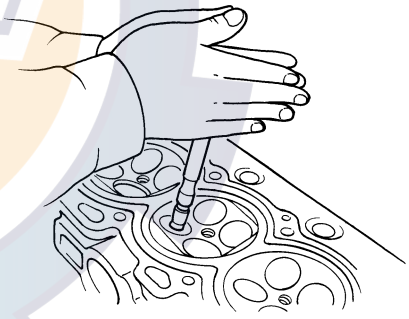
8. If the valve seat contact area is too narrow and situated near the bottom edge of the valve face, use a 60° cutter to cut the bottom edge of the valve seat. If necessary, use a 45° cutter to center the area and set its width.



S69J5930

ⓑ Previous contact width

9. Apply a thin, even layer of lapping compound onto the valve seat, and then lap the valve using a valve lapper (commercially available).



S69J5820

CAUTION:

Do not get the lapping compound on the valve stem and valve guide.

10. After every lapping procedure, be sure to clean off any remaining lapping compound from the cylinder head and the valve.

11. Check the valve seat contact area of the valve again.

Checking the camshafts

1. Measure the cam lobe. Replace if out of specification.

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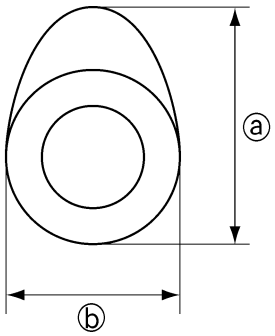
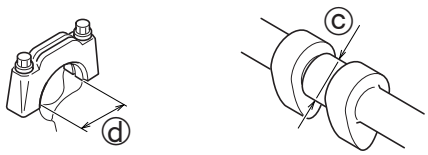


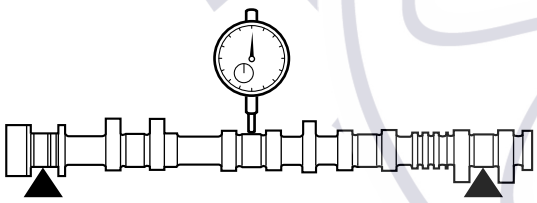
S69J5950



S69J5970

Cam lobe ⓐ:
Intake:
36.48–36.58 mm
(1.4362–1.4402 in)
Exhaust:
36.90–37.06 mm
(1.4528–1.4591 in)
Cam lobe ⓑ:
Intake:
29.95–30.05 mm
(1.1791–1.1831 in)
Exhaust:
29.92–30.08 mm
(1.1780–1.1842 in)

2. Measure the camshaft runout. Replace if above specification.



S6D85450

Camshaft runout limit:
0.03 mm (0.0012 in)

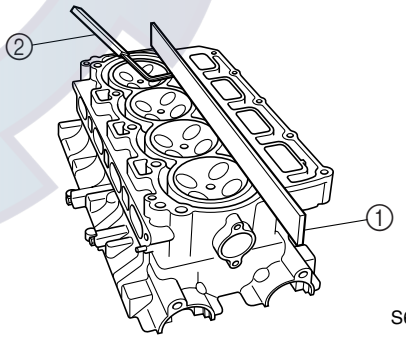
3. Measure the camshaft journal diameter ⓒ and cylinder head journal inside diameter ⓓ. Replace the camshaft and cylinder head if out of specification.

Camshaft journal diameter ⓒ:
24.960–24.980 mm
(0.9827–0.9835 in)
Camshaft cap inside diameter ⓓ:
25.000–25.021 mm
(0.9843–0.9851 in)

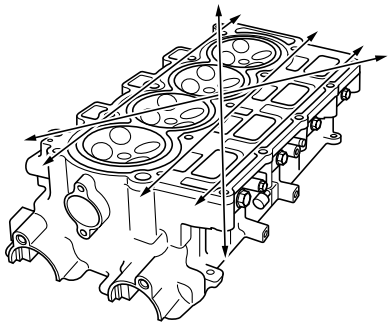
Checking the cylinder head

1. Eliminate carbon deposits from the combustion chambers and check for deterioration.

2. Check the cylinder head warpage using a straightedge ① and thickness gauge ② in the directions shown. Replace if above specification.



S6D85470



S6D85460

Cylinder head warpage limit:
0.1 mm (0.0039 in)

5

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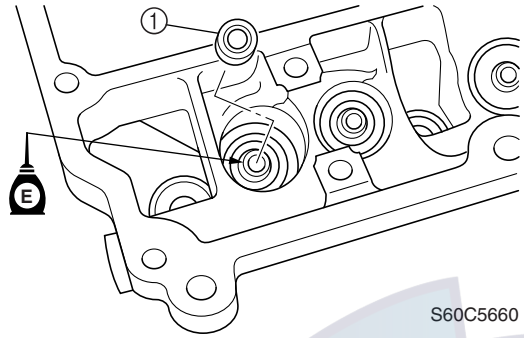
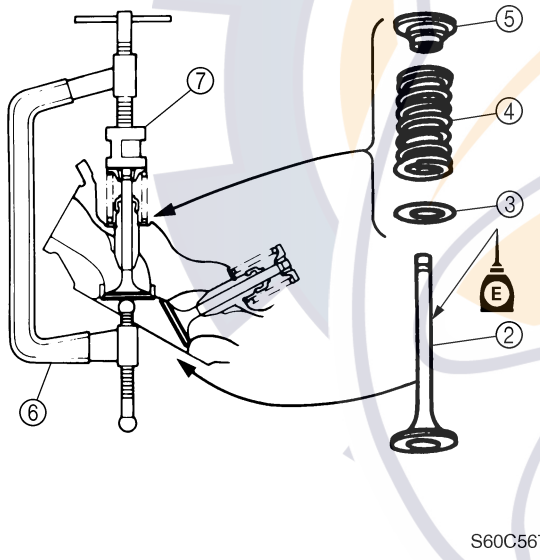
Installing the valves

1. Install a new valve seal ① onto the valve guide.



S60C5660

2. Install the valve ②, valve spring seat ③, valve spring ④, and valve spring retainer ⑤ in the sequence shown, and then attach the special service tools.

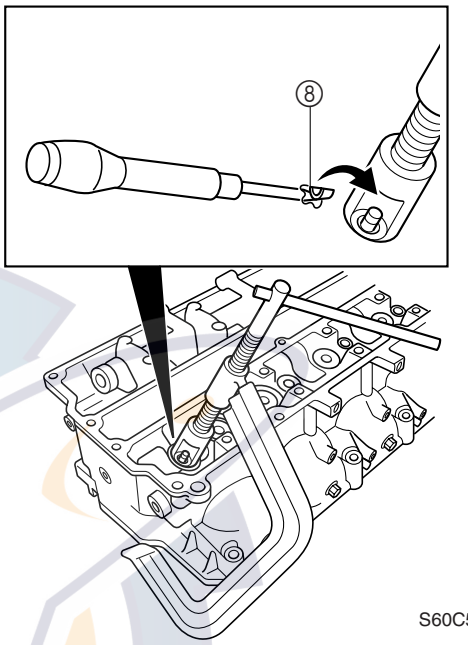


S60C5670

NOTE:
The valve spring can be installed in any direction.

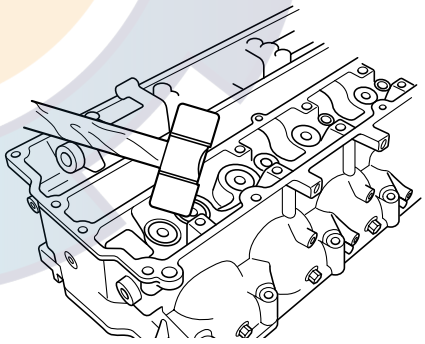
Valve spring compressor ⑥:
YM-01253
Valve spring compressor attachment ⑦:
YB-06320

3. Compress the valve spring, and then install the valve cotters ⑧ using a thin screwdriver with a small amount of grease applied to it.



S60C5680

4. Lightly tap the valve spring retainer with a plastic hammer to set the valve cotters securely.



S60C5690

Installing the cylinder head

1. Check that the piston of cylinder #1 is at TDC.

2. Install a new gasket and the cylinder head, and then tighten the bolts to the specified torques in the sequence shown.

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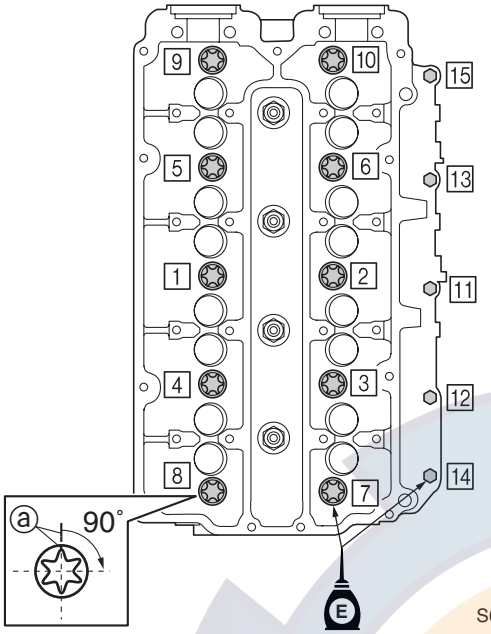


S6D85480

CAUTION:

Do not reuse the cylinder head gasket, always replace it with a new one.

NOTE:

- Apply engine oil to the cylinder head bolts before installation.
- Tighten the M10 bolts to the specified torques in two stages first, and then tighten the M8 bolts to 14 N·m (1.4 kgf·m, 10.3 ft·lb).
- Make a mark ⓐ on the M10 bolts and the cylinder head, and then tighten the bolts 90° from the mark.
- Tighten the M8 bolts to 28 N·m (2.8 kgf·m, 20.7 ft·lb).

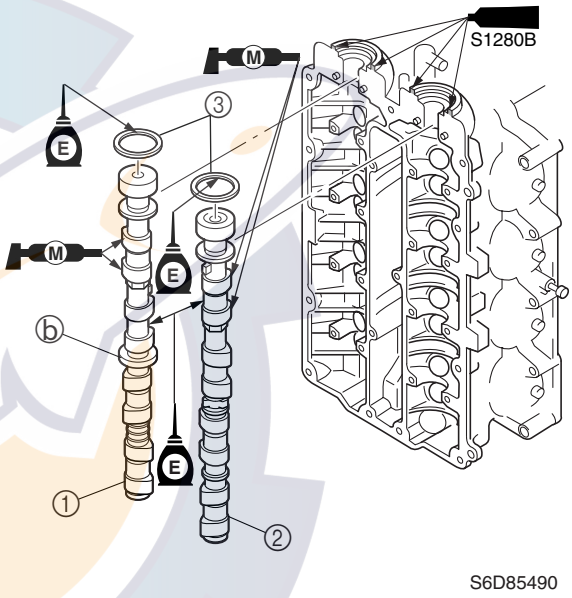
Cylinder head bolt (M10):
1st: 15 N·m (1.5 kgf·m, 11.1 ft·lb)
2nd: 30 N·m (3.0 kgf·m, 22.1 ft·lb)
3rd: 90°
Cylinder head bolt (M8):
1st: 14 N·m (1.4 kgf·m, 10.3 ft·lb)
2nd: 28 N·m (2.8 kgf·m, 20.7 ft·lb)

3. Install the valve shims and valve lifters.

NOTE:

- Apply engine oil to the valve shims and valve lifters before installation.
- Install the valve shims and valve lifters in their original positions.

4. Install the camshaft (intake) ① and camshaft (exhaust) ② with the new oil seals ③.

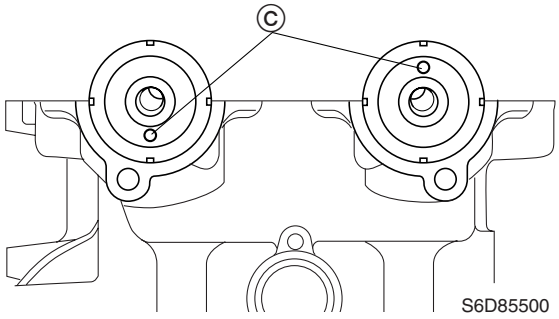


S6D85490

NOTE:

- Apply molybdenum disulfide grease to the cam lobes.
- Be sure to install the camshaft with the fuel pump drive cam ⓑ on the intake side.

5. Check that the camshaft dowel holes ⓒ are in the position shown in the illustration. Adjust if necessary.



S6D85500

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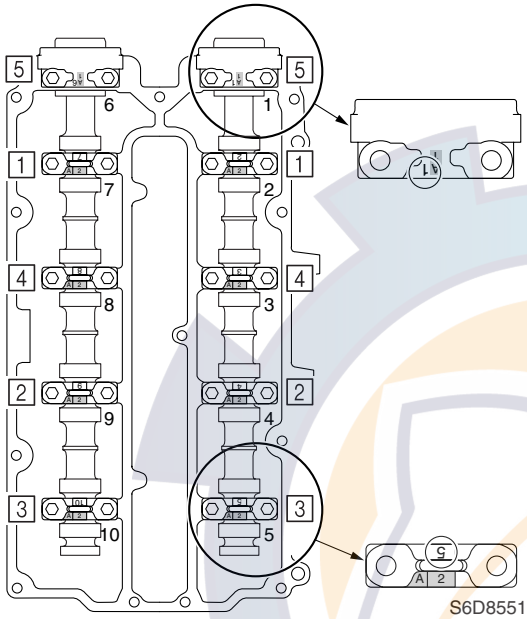
6. Install the camshaft caps in the proper position as shown and with the stamped numbers facing upside down.

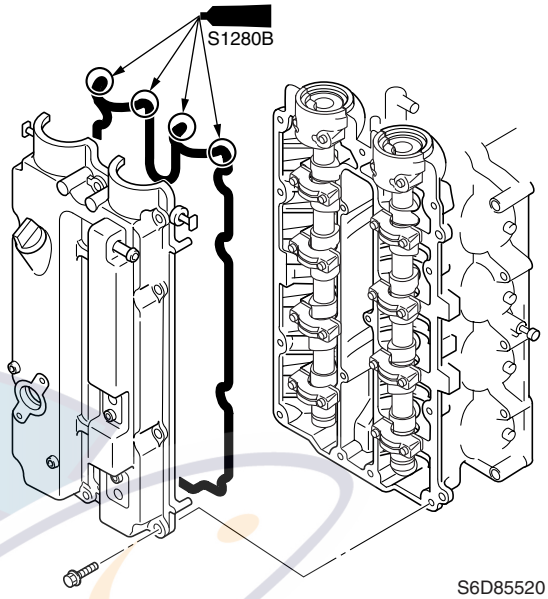
7. Tighten the camshaft cap bolts to the specified torques in two stages and in the sequence shown.



NOTE:
Apply engine oil to the camshaft caps and camshaft cap bolts before installation.

Camshaft cap bolt:
1st: 8 N·m (0.8 kgf·m, 5.9 ft·lb)
2nd: 17 N·m (1.7 kgf·m, 12.5 ft·lb)

8. Install the cylinder head cover.



Cylinder head cover bolt:
1st: 8 N·m (0.8 kgf·m, 5.9 ft·lb)
2nd: 8 N·m (0.8 kgf·m, 5.9 ft·lb)

9. Install the sprockets and timing belt.

NOTE:
For sprocket and timing belt installation procedures, see “Installing the sprockets and timing belt.”

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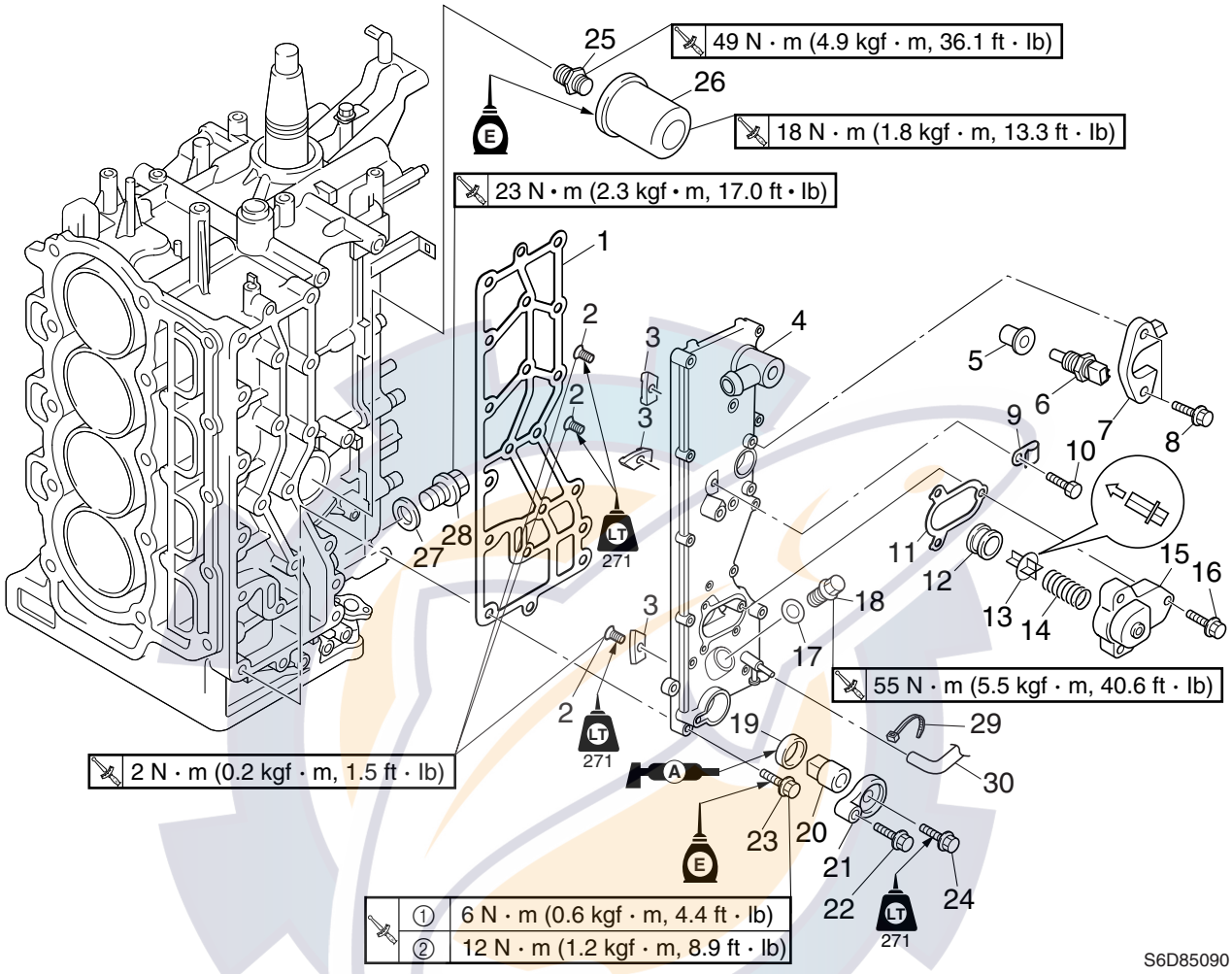
Exhaust cover



No.	Part name	Q'ty	Remarks
1	Gasket	1	**Not reusable**
2	Screw	3	ø4 × 13 mm
3	Anode	3	
4	Exhaust cover	1	
5	Gasket	1	**Not reusable**
6	Cooling water temperature sensor	1	
7	Holder	1	
8	Bolt	2	M6 × 15 mm
9	Holder	1	
10	Bolt	1	M6 × 10 mm
11	Gasket	1	**Not reusable**
12	Grommet	1	
13	Pressure control valve	1	
14	Spring	1	
15	Cover	1	
16	Bolt	3	M6 × 20 mm
17	Gasket	1	**Not reusable**

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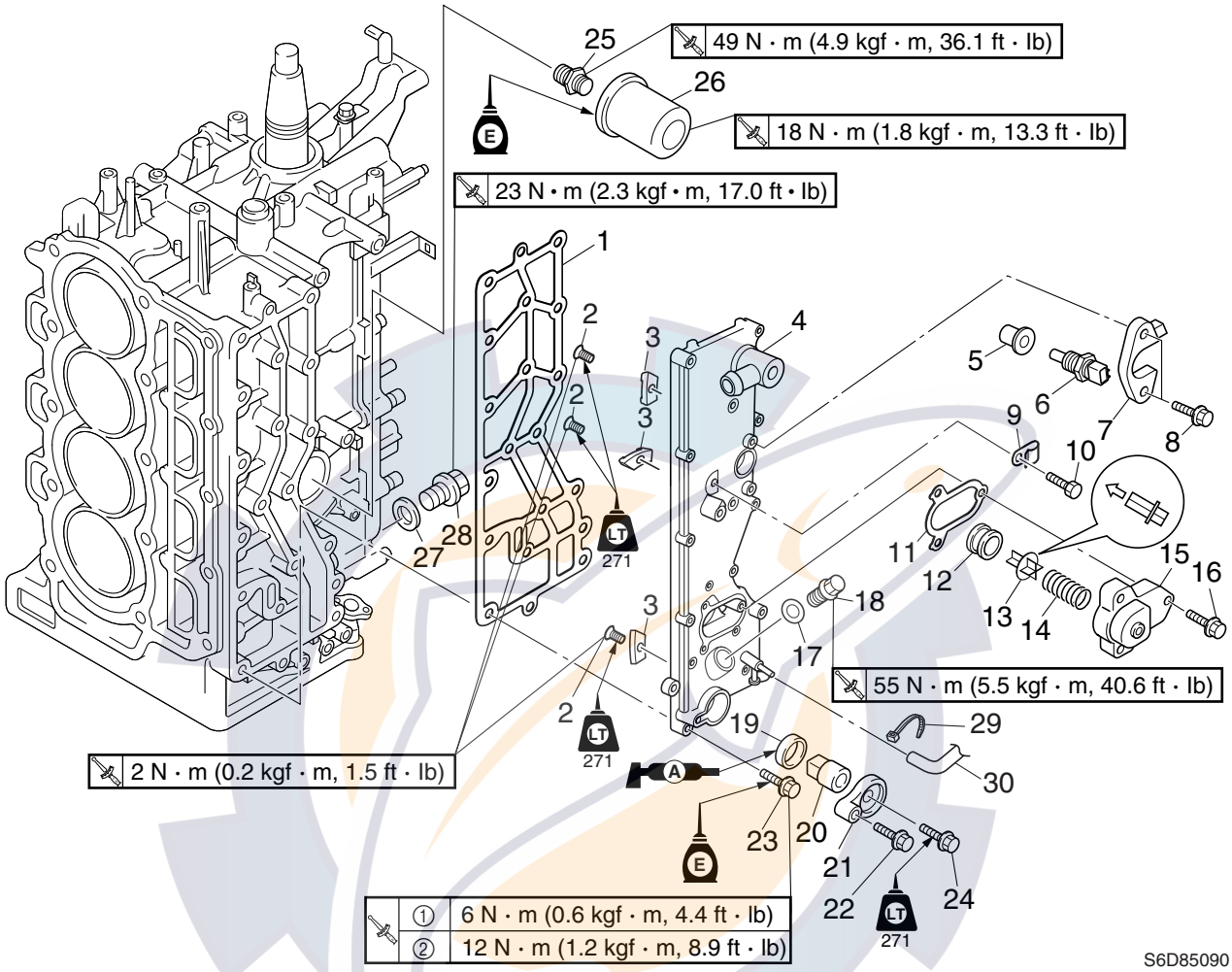
49 N · m (4.9 kgf · m, 36.1 ft · lb)
18 N · m (1.8 kgf · m, 13.3 ft · lb)
23 N • m (2.3 kgf • m, 17.0 ft • lb)
55 N · m (5.5 kgf · m, 40.6 ft · lb)
2 N · m (0.2 kgf · m, 1.5 ft · lb)
① 6 N · m (0.6 kgf · m, 4.4 ft · lb)
② 12 N · m (1.2 kgf · m, 8.9 ft · lb)
271
S6D85090

No.	Part name	Q'ty	Remarks
18	Plug	1	M18 × 17 mm
19	Grommet	1	
20	Anode	1	
21	Cover	1	
22	Bolt	1	M8 × 25 mm
23	Bolt	18	M6 × 30 mm
24	Bolt	1	M6 × 20 mm
25	Joint	1	
26	Oil filter	1	
27	Gasket	1	**Not reusable**
28	Plug	1	M14 × 12 mm
29	Plastic tie	1	**Not reusable**
30	Hose	1	

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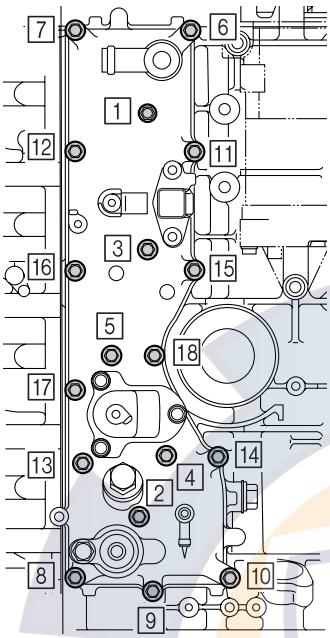
Removing the exhaust cover

1. Remove the exhaust cover bolts in the sequence shown.



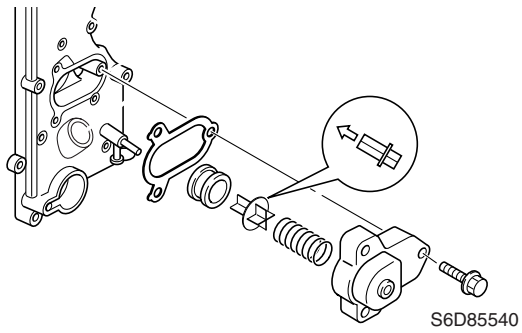
2. Remove the exhaust cover.

Checking the pressure control valve

1. Remove the pressure control valve.
2. Check the pressure control valve for wear or damage. Replace if necessary.
3. Check the grommet for deformation. Replace if necessary.
4. Check the spring for fatigue or deformation. Replace if necessary.

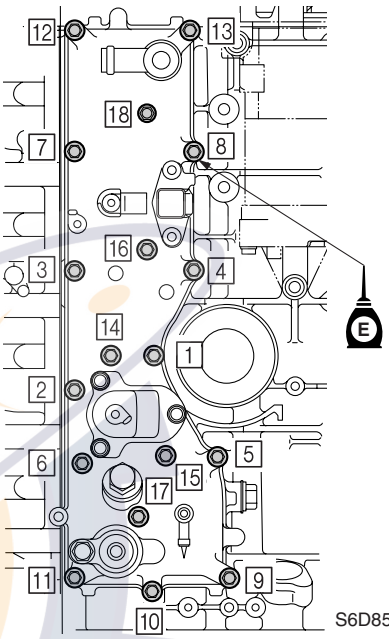
Installing the pressure control valve

1. Install a new gasket and the pressure control valve, and then tighten the bolts.



Installing the exhaust cover

1. Install a new gasket and the exhaust cover.
2. Install the bolts, and then tighten them to the specified torques in two stages and in the sequence shown.



NOTE:

Apply engine oil to the exhaust cover bolts before installation.

	Exhaust cover bolt: 1st: 6 N·m (0.6 kgf·m, 4.4 ft·lb) 2nd: 12 N·m (1.2 kgf·m, 8.9 ft·lb)

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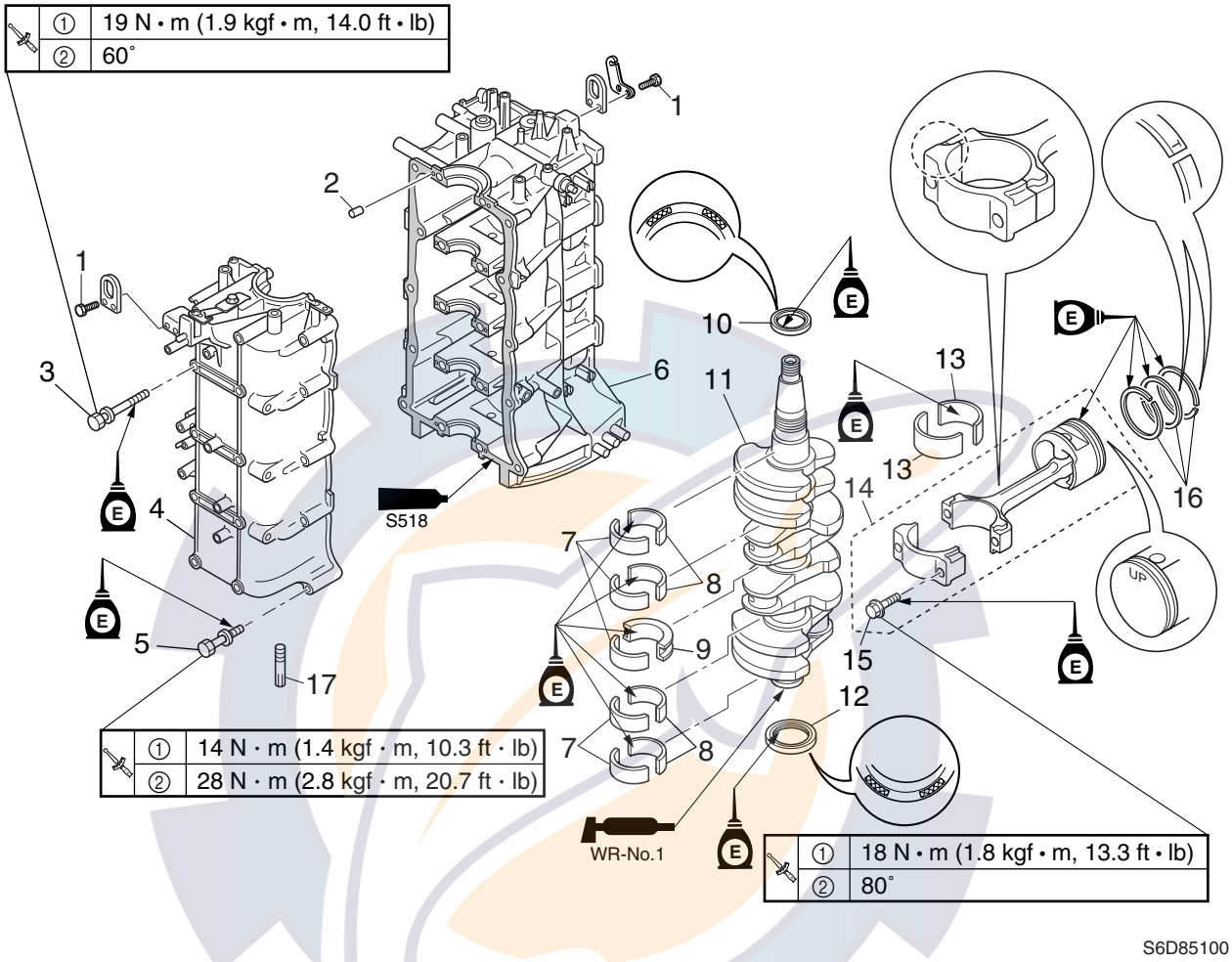
Cylinder block



No.	Part name	Q'ty	Remarks
1	Bolt	4	M6 × 20 mm
2	Dowel	10	
3	Bolt	10	M10 × 135 mm
4	Crankcase	1	
5	Bolt	10	M8 × 55 mm
6	Cylinder block	1	
7	Main bearing	5	
8	Main bearing	4	
9	Main bearing	1	
10	Oil seal	1	**Not reusable**
11	Crankshaft	1	
12	Oil seal	1	**Not reusable**
13	Connecting rod bearing	8	
14	Piston/connecting rod assembly	4	
15	Bolt	8	**Not reusable** M8 × 38 mm
16	Piston ring set	4	
17	Stud bolt	2	

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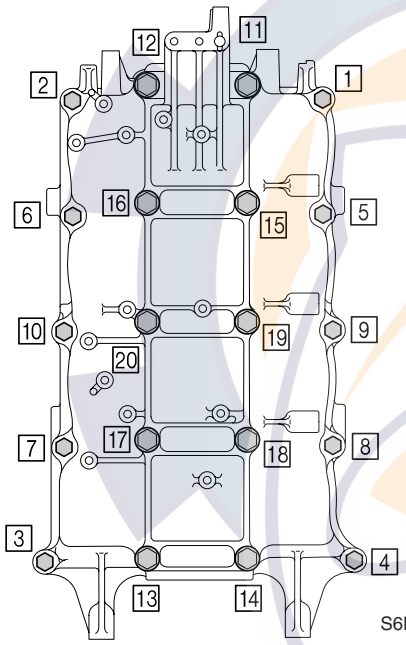
Disassembling the cylinder block

1. Place a rag under the oil filter, and then remove the filter using the oil filter wrench.

NOTE:
Be sure to clean up any oil spills.

Oil filter wrench: YU-38411

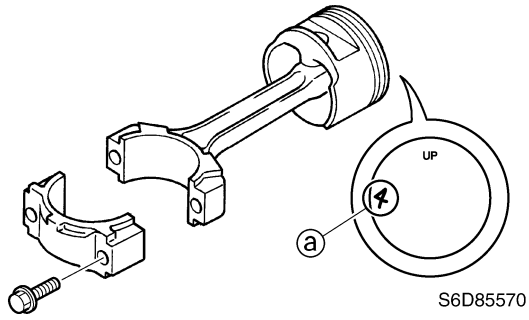
2. Remove the crankcase bolts in the sequence shown, and then remove the crankcase.



S6D85560

NOTE:
Do not remove the ignition timing pointer from the crankcase.

3. Remove the connecting rod bolts and the connecting rod caps, and then remove the crankshaft, oil seals, and the piston assemblies.

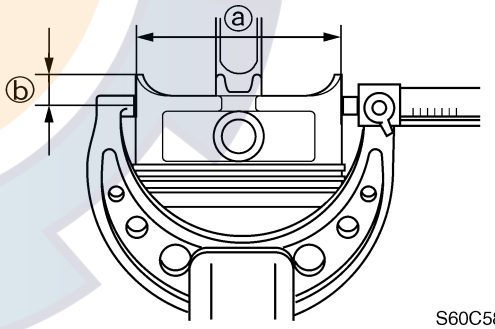


S6D85570

NOTE:
- Be sure to keep the bearings in the order as they were removed.
- Mark each piston with an identification number ⓐ of the corresponding cylinder.
- Do not mix the connecting rods and caps. Keep them organized in their proper groups.

Checking the piston diameter

1. Measure the piston outside diameter at the specified measuring point. Replace if out of specification.



S60C5820

Piston diameter ⓐ:
78.928–78.949 mm
(3.1074–3.1082 in)
Measuring point ⓑ:
13.0 mm (0.51 in) up from the bottom of the piston skirt
Oversize piston diameter:
79.178–79.199 mm
(3.1172–3.1181 in)

5

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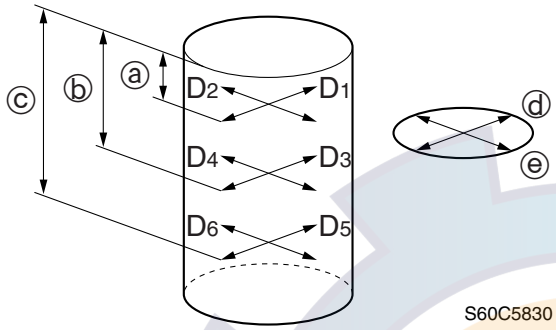
Checking the cylinder bore

1. Measure the cylinder bore (D_1–D_6) at measuring points ⓐ, ⓑ, and ⓒ, and in direction ⓓ (D_1, D_3, D_5), which is parallel to the crankshaft, and direction ⓔ (D_2, D_4, D_6), which is at a right angle to the crankshaft.



S60C5830

ⓐ 20 mm (0.8 in)
ⓑ 50 mm (2.0 in)
ⓒ 80 mm (3.1 in)

Cylinder bore (D_1–D_6):
79.000–79.020 mm
(3.1102–3.1110 in)

2. Calculate the taper limit. Replace or rebore the cylinder block if above specification.

Taper limit:
D_1–D_5 (direction ⓓ)
D_2–D_6 (direction ⓔ)
0.08 mm (0.0031 in)

3. Calculate the out-of-round limit. Replace or rebore the cylinder block if above specification.

Out-of-round limit:
D_2–D_1 (measuring point ⓐ)
D_6–D_5 (measuring point ⓒ)
0.05 mm (0.0020 in)

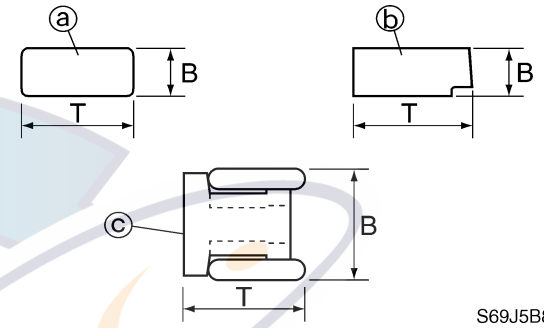
Checking the piston clearance

1. Calculate the piston clearance using the piston outside diameter and the cylinder bore. Replace the piston and piston rings as a set or the cylinder block or all parts, or rebore the cylinder if out of specification.

Piston clearance:
0.070–0.080 mm
(0.0028–0.0031 in)

Checking the piston rings

1. Check the piston ring dimensions of B and T. Replace if out of specification.



S69J5B80

Piston ring dimensions:
Top ring ⓐ:
B: 1.17–1.19 mm
(0.0461–0.0469 in)
T: 2.80–3.00 mm
(0.1102–0.1181 in)
Second ring ⓑ:
B: 1.47–1.49 mm
(0.0579–0.0587 in)
T: 3.00–3.20 mm
(0.1181–0.1260 in)
Oil ring ⓒ:
B: 2.38–2.48 mm
(0.0937–0.0976 in)
T (reference data):
2.40 mm (0.0945 in)

2. Level the piston ring ① in the cylinder with a piston crown.

3. Check the piston ring end gap ⓓ at the specified measuring point. Replace if out of specification.

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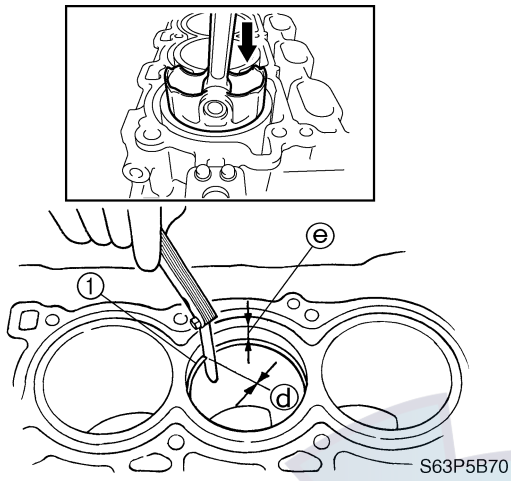
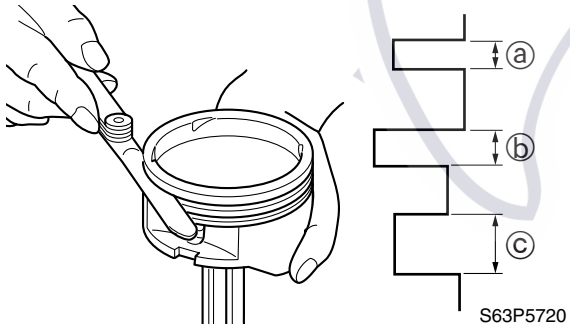


Piston ring end gap ⓓ:
- Top ring:
  0.15–0.30 mm
  (0.0059–0.0118 in)
- Second ring:
  0.70–0.90 mm
  (0.0276–0.0354 in)
- Oil ring:
  0.20–0.70 mm
  (0.0079–0.0276 in)

Measuring point ⓔ: 20 mm (0.8 in)

Checking the piston ring grooves

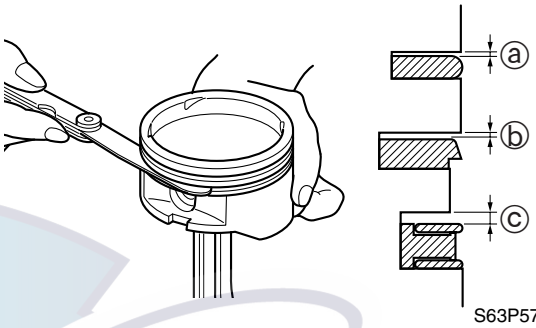
1. Measure the piston ring grooves. Replace the piston if out of specification.



Piston ring groove:
- Top ring ⓐ:
  1.23–1.25 mm (0.048–0.049 in)
- Second ring ⓑ:
  1.52–1.54 mm (0.060–0.061 in)
- Oil ring ⓒ:
  2.51–2.53 mm (0.099–0.100 in)

Checking the piston ring side clearance

1. Measure the piston ring side clearance. Replace the piston and piston rings as a set if out of specification.



Piston ring side clearance:
- Top ring ⓐ:
  0.04–0.08 mm
  (0.0016–0.0031 in)
- Second ring ⓑ:
  0.03–0.07 mm
  (0.0012–0.0028 in)
- Oil ring ⓒ:
  0.03–0.15 mm
  (0.0012–0.0059 in)

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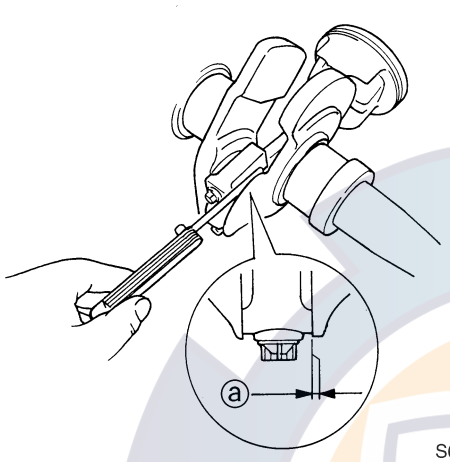
Checking the connecting rod big end side clearance

1. Measure the connecting rod big end side clearance ⓐ. Replace the connecting rod or crankshaft or both if out of specification.

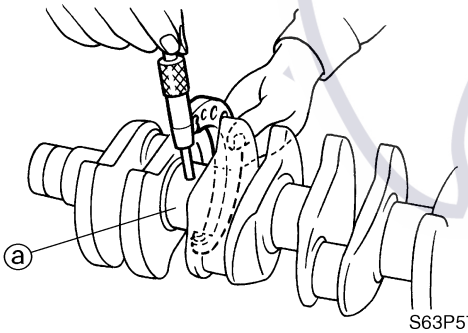


S6D85580

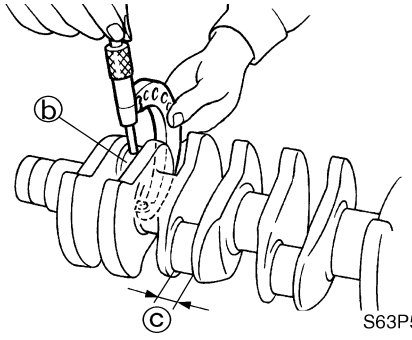
Connecting rod big end side clearance ⓐ:
0.14–0.28 mm (0.0055–0.0110 in)

Checking the crankshaft

1. Measure the crankshaft journal diameter ⓐ, crankpin diameter ⓑ, and crankpin width ⓒ. Replace the crankshaft if out of specification.



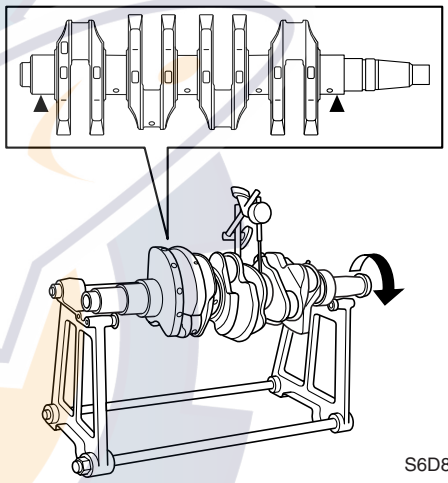
S63P5750



S63P5760

Crankshaft journal diameter ⓐ:
47.985–48.000 mm
(1.8892–1.8898 in)
Crankpin diameter ⓑ:
43.982–44.000 mm
(1.7316–1.7323 in)
Crankpin width ⓒ:
21.00–21.07 mm
(0.8268–0.8295 in)

2. Measure the crankshaft runout. Replace the crankshaft if above specification.



S6D85590

Crankshaft runout limit:
0.03 mm (0.0012 in)

Checking the crankpin oil clearance

1. Clean the bearings and the connecting rod.

2. Install the upper bearing into the connecting rod ① and the lower bearing into the connecting rod cap ②.

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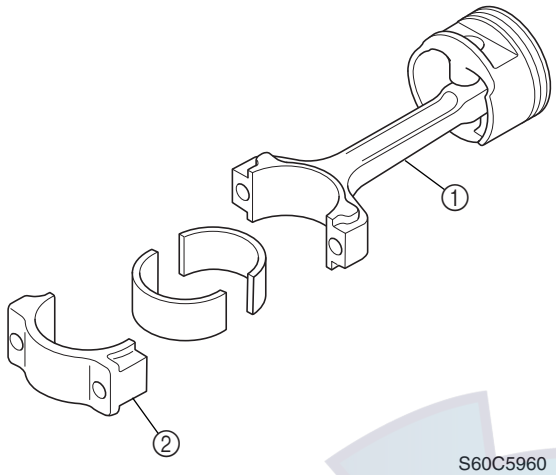
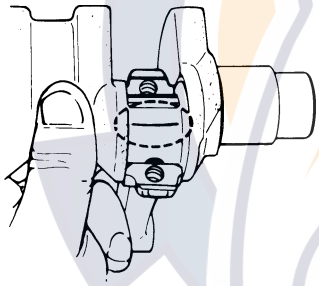


S60C5960

NOTE:
Install the bearings in their original positions.

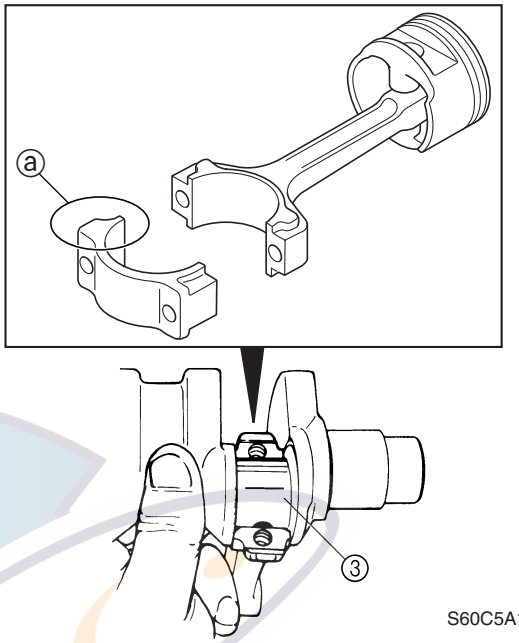
3. Put a piece of Plastigauge (PG-1) onto the crankpin, parallel to the crankshaft.



S60C5990

NOTE:
Be sure not to put the Plastigauge (PG-1) over the oil hole in the crankpin of the crankshaft.

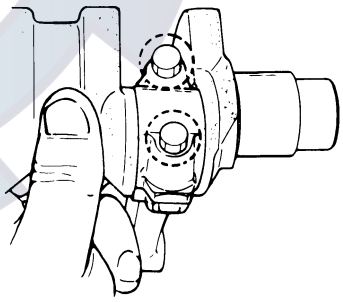
4. Install the connecting rod to the crankpin ③.



S60C5A10

NOTE:
Make sure that the large, flat side ⓐ on the connecting rod faces towards the flywheel magnet side of the crankshaft.

5. Tighten the connecting rod bolts to the specified torques in two stages.



S62Y5980

NOTE:
- Reuse the removed connecting rod bolts.
- Do not turn the connecting rod until the crankpin oil clearance measurement has been completed.

	Connecting rod bolt: 1st: 18 N·m (1.8 kgf·m, 13.3 ft·lb) 2nd: 80°

5

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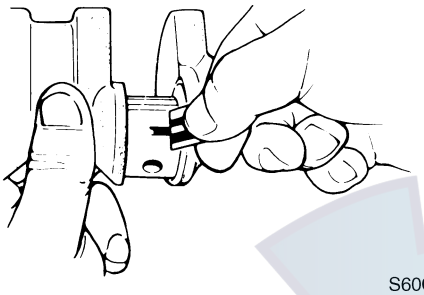
6. Remove the connecting rod cap and measure the width of the compressed Plastigauge (PG-1) on each crankpin. Replace the connecting rod bearing if out of specification.



S60C5A30

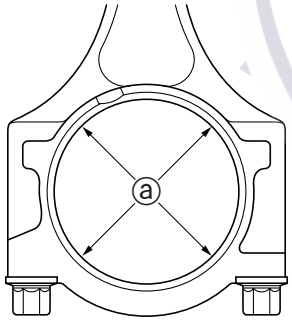
Crankpin oil clearance:
0.024–0.044 mm
(0.0009–0.0017 in)

Selecting the connecting rod bearing

NOTE:
Use a metric gauge in this procedure.

1. When replacing the connecting rod bearing, select the suitable bearing as follows.

2. Measure the connecting rod big end inside diameter ⓐ.

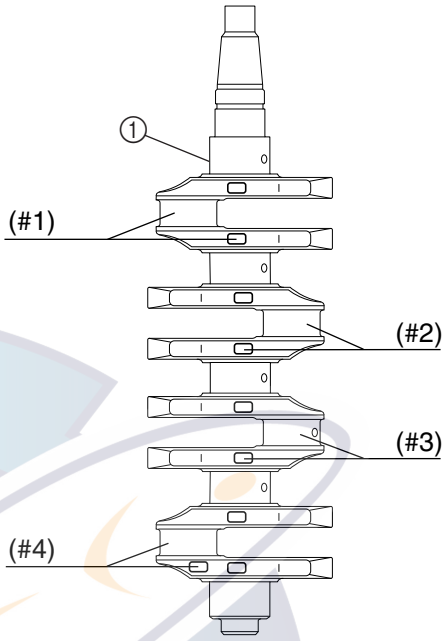


S60C5980

NOTE:
Reuse the removed connecting rod bolts.

Connecting rod big end inside diameter ⓐ:
47.025–47.045 mm

3. Check the crankpin mark on the crankshaft ①.

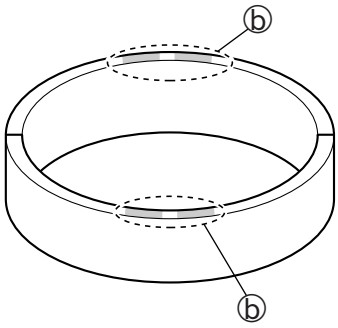


S6D85670

4. Subtract the crankpin diameters (#1–#4) from the connecting rod big end inside diameters (#1–#4).

NOTE:
The crankpin diameters (#1–#4) can be determined by the stamped value as described below.
Crankpin diameter = 43.900 + (stamped value/1,000)
Example: #1 = 92 → 43.992

5. Select the suitable color ⓑ for the connecting rod bearing from the table below according to the calculated values.



S6D85710

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Connecting rod bearing selection table (20 °C [68 °F])		
Connecting rod big end inside diameters – crankpin diameters (mm)	Upper bearing	Lower bearing
3.025–3.027	Yellow	Yellow
3.028–3.034	Yellow	Green*
3.035–3.041	Green	Green
3.042–3.049	Green	Blue*
3.050–3.057	Blue	Blue
3.058–3.063	Blue	Red*

CAUTION:

The (*) mark indicates that the colors of the upper and lower bearings are different.

Example:
If the "Connecting rod big end inside diameter ⓐ" is 47.050 mm and the "Crankpin mark" is 92, then the "Calculated value" = 47.050 – 43.992 = 3.058 mm
Suitable colors:
Upper bearing → blue
Lower bearing → red

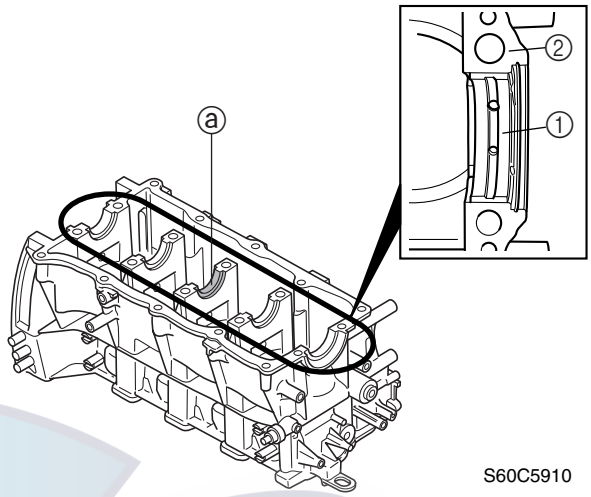
6. If the calculated value is more than the maximum value (3.063 mm), replace the connecting rod or crankshaft or both.

Checking the crankshaft journal oil clearance

1. Clean the bearings, the crankshaft journals, the bearing portions of the crankcase, and the cylinder block.

2. Place the cylinder block upside down on a bench.

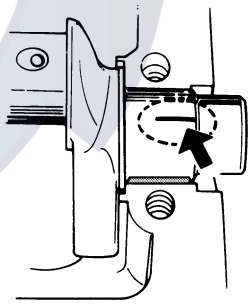
3. Install half of the bearings ① and the crankshaft into the cylinder block ②.



S60C5910

NOTE:
- Install the bearings in their original positions.
- Install the unified thrust bearing at the position ⓐ shown.

4. Put a piece of Plastigauge (PG-1) on each crankshaft journal parallel to the crankshaft.


S60C5920

NOTE:
Do not put the Plastigauge (PG-1) over the oil hole in the main journals of the crankshaft.

5. Install the remaining half of the bearings into the crankcase.

6. Install the crankcase onto the cylinder block and apply engine oil onto the threads of the crankcase bolts.

5

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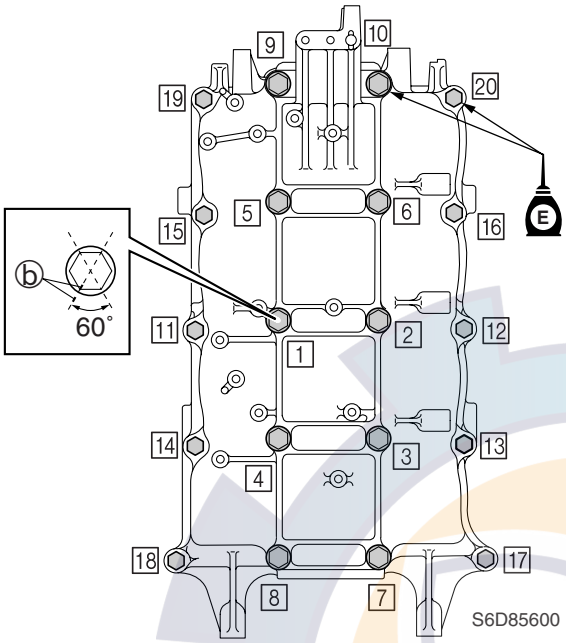
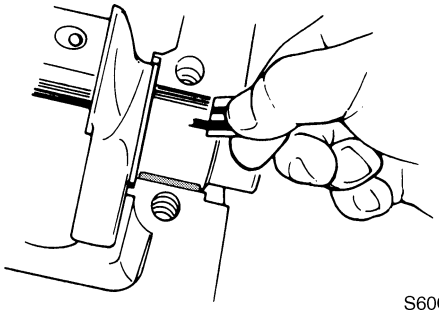
7. Tighten the crankcase bolts to the specified torques in two stages and in the sequence shown.



NOTE:
- Do not move the crankshaft until the crankshaft journal oil clearance measurement has been completed.
- Tighten the M10 bolts to 19 N·m (1.9 kgf·m, 14.0 ft·lb) first, and then tighten the M8 bolts to 14 N·m (1.4 kgf·m, 10.3 ft·lb).
- Make a mark ⓑ on the M10 bolts and the crankcase, and then tighten the bolts 60° from the mark.
- Tighten the M8 bolts to 28 N·m (2.8 kgf·m, 20.7 ft·lb).

Crankcase bolt (M10):
1st: 19 N·m (1.9 kgf·m, 14.0 ft·lb)
2nd: 60°
Crankcase bolt (M8):
1st: 14 N·m (1.4 kgf·m, 10.3 ft·lb)
2nd: 28 N·m (2.8 kgf·m, 20.7 ft·lb)

8. Remove the crankcase, and then measure the width of the compressed Plastigauge (PG-1) on each crankshaft journal. Replace the main bearing if out of specification.

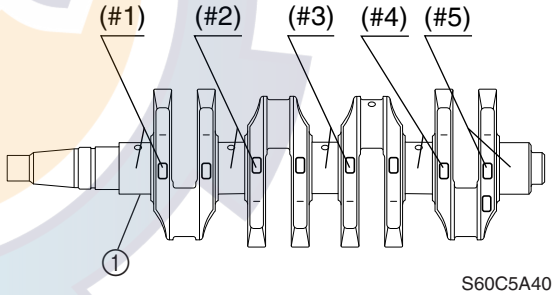


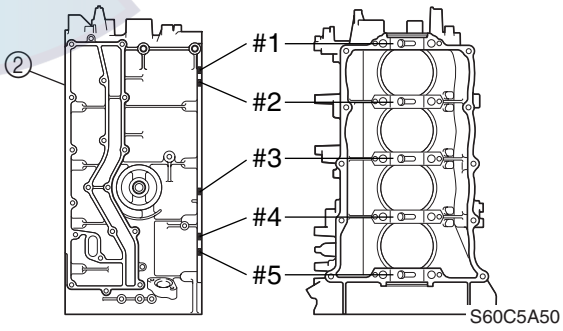
Crankshaft journal oil clearance:
0.024–0.044 mm
(0.0009–0.0017 in)

Selecting the main bearing

1. When replacing the main bearing, select the suitable bearing as follows.

2. Check the crankshaft journal mark on the crankshaft ① and the cylinder block mark on the cylinder block ②.





3. Subtract crankshaft journal diameters #1–#5 from cylinder block journal inside diameters #1–#5.

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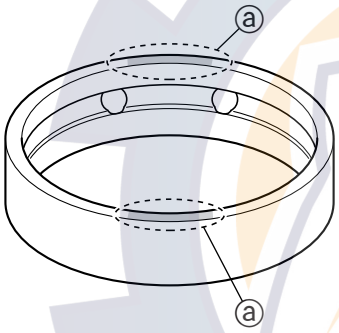
NOTE:
Cylinder block journal inside diameters (#1–#5) and crankshaft journal diameters (#1–#5) can be determined by the stamped value as described below.
Crankshaft journal diameter = 47.900 + (stamped value/1,000)
Example: #1 = 92 → 47.992
Cylinder block journal inside diameter = 54.000 + (stamped value/1,000)
Example: #1 = 32 → 54.032

4. Select the suitable color ⓐ for the main bearing from the table below according to the calculated values.



S6D85720

Main bearing selection table (20 °C [68 °F])		
Cylinder block journal inside diameters – crankshaft journal diameters (mm)	Bearing (cylinder side)/thrust bearing	Bearing (crankcase side)
6.023–6.026	Green	Yellow*
6.027–6.034	Blue	Green*
6.035–6.042	Blue	Blue
6.043–6.049	Red	Blue*
6.050–6.058	Red	Red

CAUTION:
- **The (*) mark indicates that the colors of the upper and lower bearings are different.**
- **Be sure to install the main bearings in the middle of the cylinder block and crankcase journal so they do not block the oil holes.**

NOTE:
Main bearing #3 is a thrust bearing.

Example:
If the “Crankshaft journal mark” is 92, and the “Cylinder block mark” is 32, then the “Calculated value” = 54.032 – 47.992 = 6.040 mm
Suitable colors:
Bearing (cylinder side)/ thrust bearing → blue
Bearing (crankcase side) → blue

5. If the calculated value is more than the maximum value (6.058 mm), replace the crankshaft.

5

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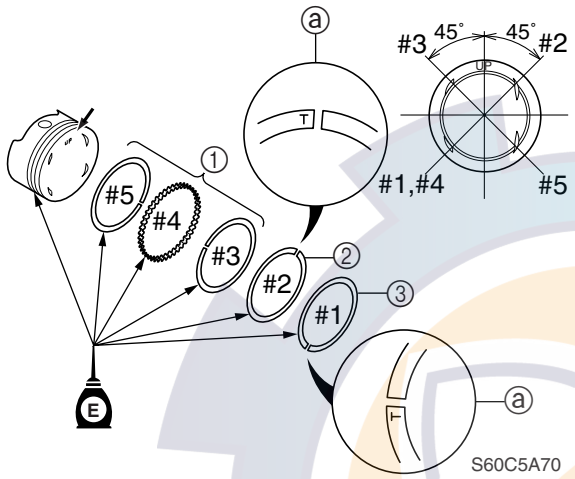
Assembling the power unit

1. Install the oil ring ①, second ring ②, and top ring ③ onto the pistons with the "T" marks ⓐ on the piston rings facing upward.

2. Offset the piston ring end gaps as shown.



S60C5A70

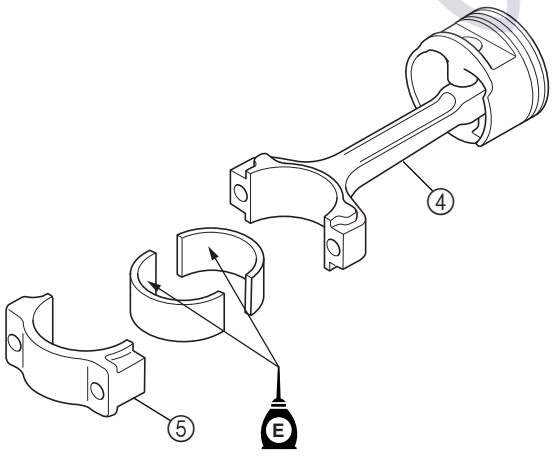
CAUTION:

Do not scratch the piston or break the piston rings.

NOTE:

After installing the piston rings, check that they move smoothly.

3. Install the upper bearing into the connecting rod ④ and the lower bearing into the connecting rod cap ⑤.

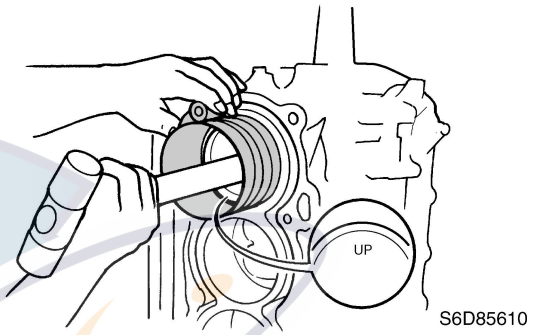


S60C5A80

NOTE:

Install the bearings in their original positions.

4. Install the piston with the "UP" mark on the piston crown facing towards the flywheel magnet.



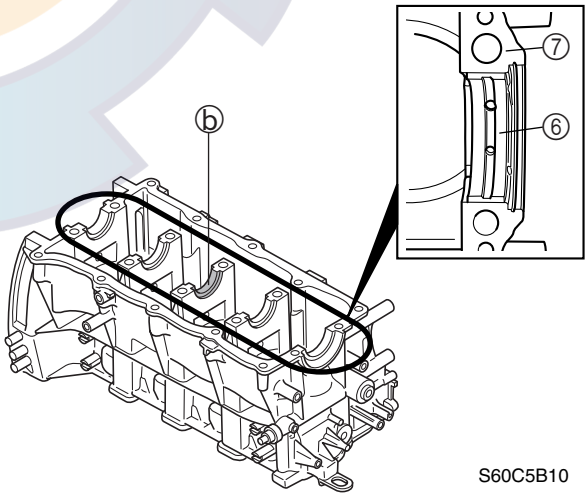
S6D85610

NOTE:

Apply engine oil to the side of the pistons and piston rings before installation.

	Piston ring compressor: YM-08037

5. Install half of the bearings ⑥ into the cylinder block ⑦.



S60C5B10

NOTE:

- Install the bearings in their original positions.
- Install the unified thrust bearing at the position ⓑ shown.

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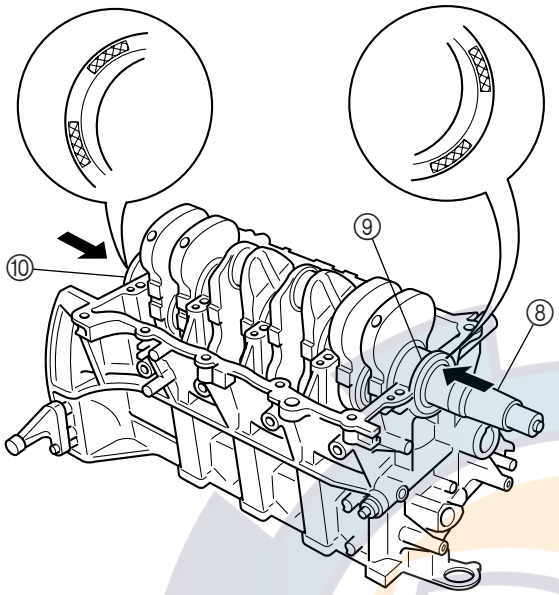
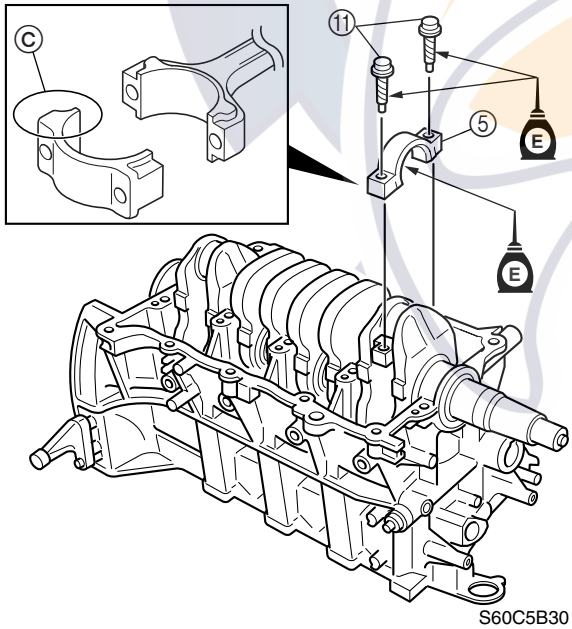
6. Set the crankshaft ⑧ and oil seals ⑨ and ⑩ into the cylinder block as shown.



S6D85700

7. Install the connecting rod cap ⑤ to the connecting rod, and then tighten the new connecting rod bolts ⑪ to the specified torques in two stages.



S60C5B30

CAUTION:

Do not reuse the connecting rod bolts, always replace them with new ones.

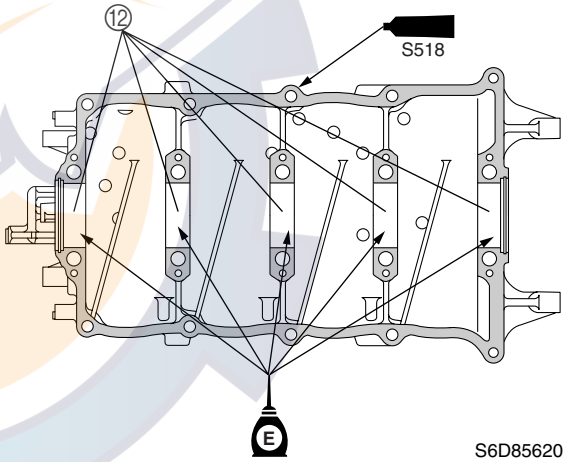
NOTE:

- Make sure that the large, flat side Ⓒ of the connecting rod faces towards the flywheel magnet side of the crankshaft.
- Apply engine oil to the connecting rod caps and connecting rod bolts before installation.

	Connecting rod bolt ⑪: 1st: 18 N·m (1.8 kgf·m, 13.3 ft·lb) 2nd: 80°

8. Install half of the bearings ⑫ into the crankcase.

9. Apply sealant to the mating surface of the crankcase.



S6D85620

NOTE:

- Install the bearings in their original positions.
- Do not get any sealant on the main bearings.

10. Install the crankcase onto the cylinder block and apply engine oil onto the threads of the crankcase bolts.

5

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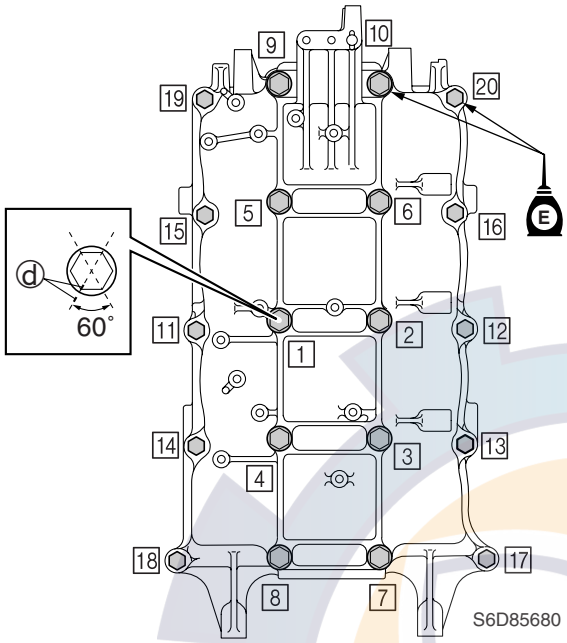
11. Tighten the crankcase bolts to the specified torques in two stages and in the sequence shown.



CAUTION:

The oil seals must be installed before tightening the crankcase bolts.

NOTE:

- Tighten the M10 bolts to 19 N·m (1.9 kgf·m, 14.0 ft·lb) first, and then tighten the M8 bolts to 14 N·m (1.4 kgf·m, 10.3 ft·lb).
- Make a mark ⓓ on the M10 bolts and the crankcase, and then tighten the bolts 60° from the mark.
- Tighten the M8 bolts to 28 N·m (2.8 kgf·m, 20.7 ft·lb).

Crankcase bolt (M10):
1st: 19 N·m (1.9 kgf·m, 14.0 ft·lb)
2nd: 60°
Crankcase bolt (M8):
1st: 14 N·m (1.4 kgf·m, 10.3 ft·lb)
2nd: 28 N·m (2.8 kgf·m, 20.7 ft·lb)

12. Install the cylinder head.

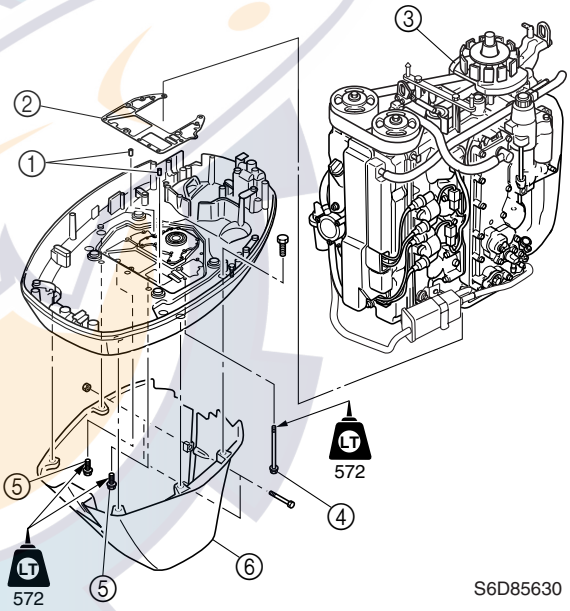
NOTE:

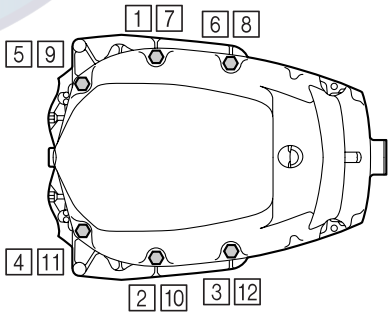
For cylinder head installation procedure, see "Installing the cylinder head."

13. Install all parts removed during disassembly.

Installing the power unit

1. Clean the power unit mating surface, and install the dowels ① and a new gasket ②.
2. Install the power unit ③ by installing bolts ④ and ⑤, then tightening them to the specified torques in two stages and in the sequence shown.
3. Install the apron ⑥.





Power unit mounting bolt ④:
1st: 42 N·m (4.2 kgf·m, 31.0 ft·lb)
2nd: 42 N·m (4.2 kgf·m, 31.0 ft·lb)
Apron screw:
4 N·m (0.4 kgf·m, 3.0 ft·lb)

4. Install the oil dipstick.

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5. Connect the flushing hose, cooling water pilot hose, and canister hose.

6. Connect the fuel hose and shift position switch coupler.

7. Connect the PTT motor leads and PTT switch coupler, and then install the junction box cover.

PTT motor lead bolt:
4 N·m (0.4 kgf·m, 3.0 ft·lb)

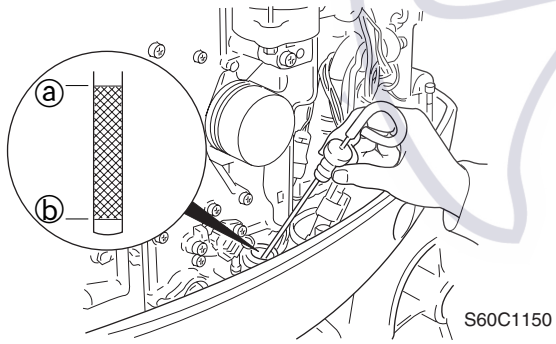
8. Connect the trim sensor coupler and battery leads.

Positive battery lead nut:
9 N·m (0.9 kgf·m, 6.6 ft·lb)

9. Connect the shift cable and throttle cable, and then adjust their lengths.
For adjustment procedures, see Chapter 3, “Adjusting the throttle link and throttle cable” and “Checking the gear shift operation.”

10. Install all parts removed during disassembly.

11. Check the engine oil level.



NOTE:
If the engine oil is below the minimum level mark ⓑ, add sufficient oil until the level is between ⓐ and ⓑ.

Recommended engine oil:
4-stroke motor oil
API: SE, SF, SG, SH, or SJ
SAE: 10W-30 or 10W-40

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Lower unit

Special service tools **6-1**

Lower unit **6-4**
Removing the lower unit 6-8
Removing the water pump and shift rod 6-9
Disassembling the oil seal housing 6-9
Checking the water pump and shift rod 6-9

Propeller shaft housing **6-10**
Removing the propeller shaft housing assembly 6-11
Disassembling the propeller shaft assembly 6-11
Disassembling the propeller shaft housing 6-11
Checking the propeller shaft housing 6-12
Checking the propeller shaft 6-12
Assembling the propeller shaft assembly 6-12
Assembling the propeller shaft housing 6-13

Drive shaft and lower case **6-15**
Removing the drive shaft 6-17
Disassembling the drive shaft 6-17
Disassembling the forward gear 6-17
Disassembling the lower case 6-17
Checking the pinion and forward gear 6-18
Checking the bearings 6-18
Checking the drive shaft 6-18
Checking the lower case 6-18
Assembling the lower case 6-19
Assembling the forward gear 6-19
Assembling the drive shaft 6-20
Installing the drive shaft 6-20
Installing the propeller shaft housing 6-20
Installing the water pump and shift rod 6-21
Installing the lower unit 6-22

Shimming **6-25**
Shimming 6-26
Selecting the pinion shims 6-26
Selecting the forward gear shims 6-27

Backlash **6-28**
Measuring the forward gear backlash 6-28

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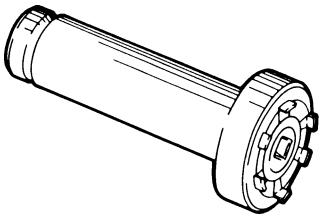
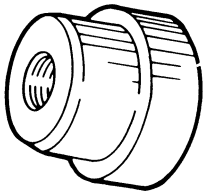
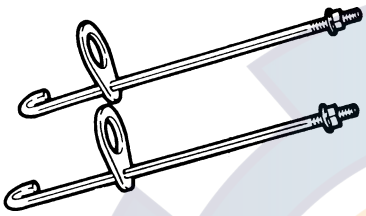
Special service tools



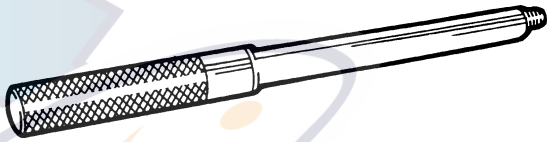
Gland nut wrench
YB-34447



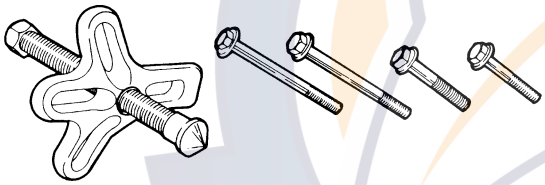
Bearing housing needle bearing remover
YB-06112, YB-06153



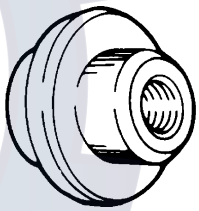
Bearing housing puller
YB-06207



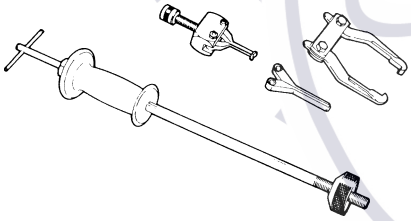
Driver handle (large)
YB-06071



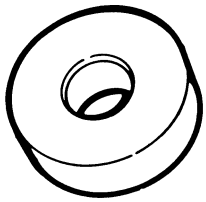
Universal puller
YB-06117



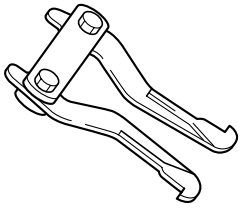
Propeller shaft oil seal installer
YB-06269



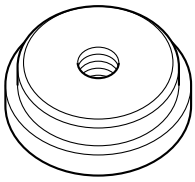
Slide hammer
YB-06096



Drive shaft needle bearing depth stop
YB-34473



Bearing puller legs
YB-06523



Bearing outer race attachment
YB-06109

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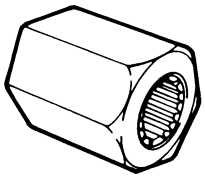
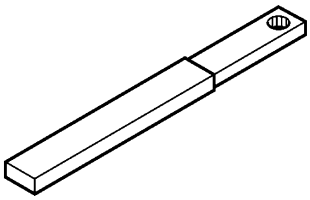
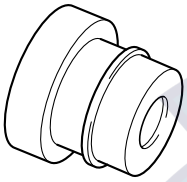


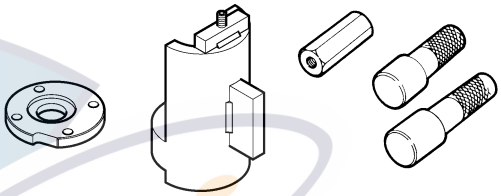
Drive shaft holder
YB-06151



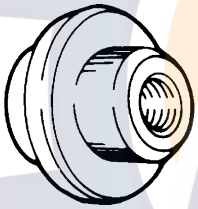
Shift rod push arm
YB-06052



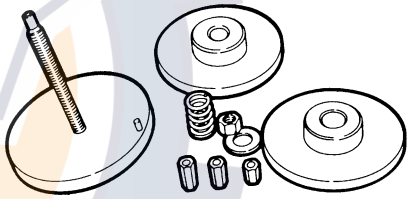
Drive shaft needle bearing remover and installer
YB-06155



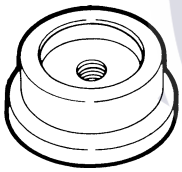
Pinion shim selecting tool
YB-34432-9, YB-34432-10A, YB-34432-11A, YB-34432-17



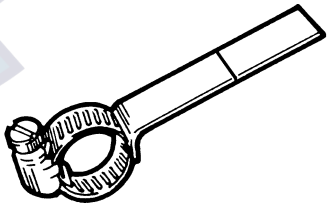
Drive shaft seal installer
YB-06244



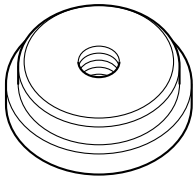
Forward gear shim selecting tool
YB-34446-1, YB-34446-3, YB-34446-5, YB-34446-7



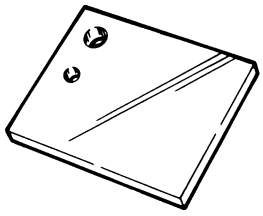
Forward gear bearing cup installer
YB-06276-B



Backlash indicator rod
YB-06265



Forward gear outer race installer
YB-06085



Backlash adjustment plate
YB-07003

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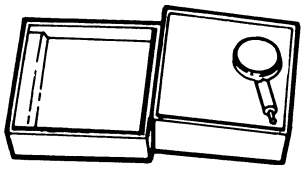
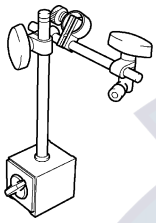


Dial indicator gauge
YU-03097



Magnetic base stand
YU-A8438

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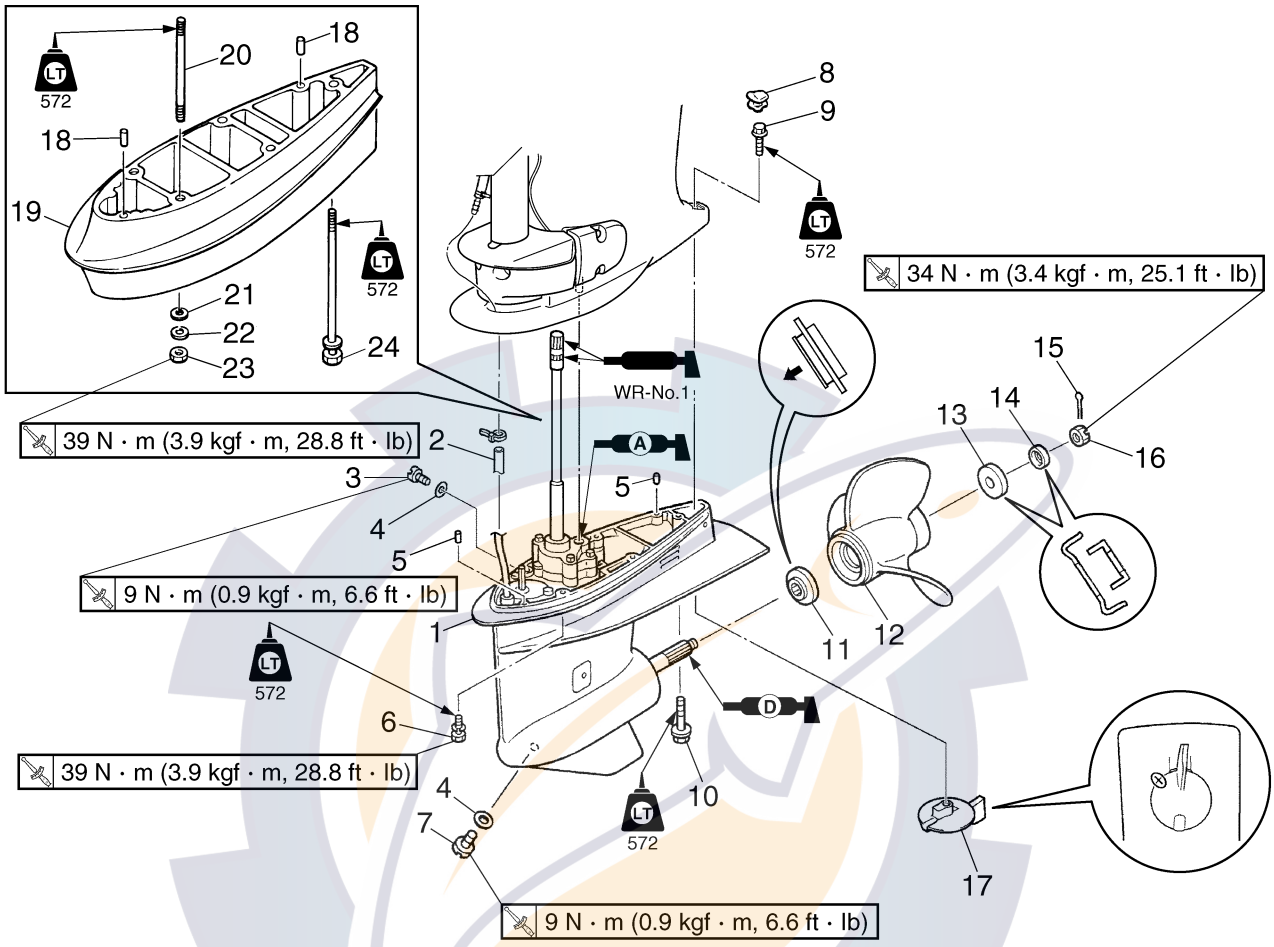
Lower unit



S6D86010

No.	Part name	Q'ty	Remarks
1	Lower unit	1	
2	Hose	1	
3	Check screw	1	
4	Gasket	2	**Not reusable**
5	Dowel	2	
6	Bolt	4	M10 × 40 mm/L-transom model
7	Drain screw	1	
8	Grommet	1	
9	Bolt	1	M10 × 45 mm
10	Bolt	1	M8 × 60 mm/L-transom model
11	Spacer	1	
12	Propeller	1	
13	Washer	1	
14	Washer	1	
15	Cotter pin	1	**Not reusable**
16	Nut	1	
17	Trim tab	1	

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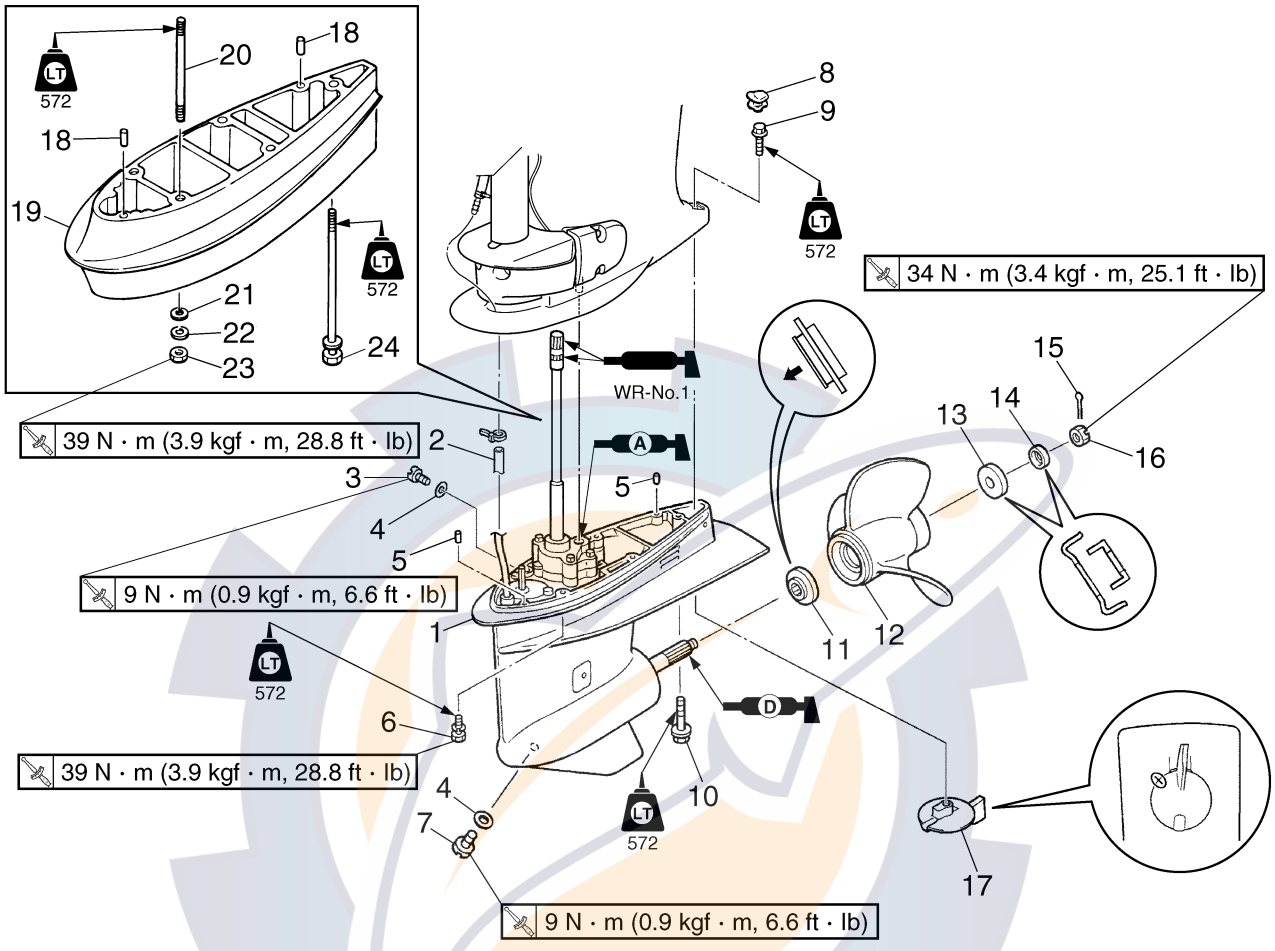

No.	Part name	Q'ty	Remarks
18	Dowel	2	X-transom model
19	Extension	1	X-transom model
20	Stud bolt	4	M10 × 180 mm/X-transom model
21	Washer	4	X-transom model
22	Spring washer	4	X-transom model
23	Nut	4	X-transom model
24	Bolt	1	M8 × 190 mm/X-transom model

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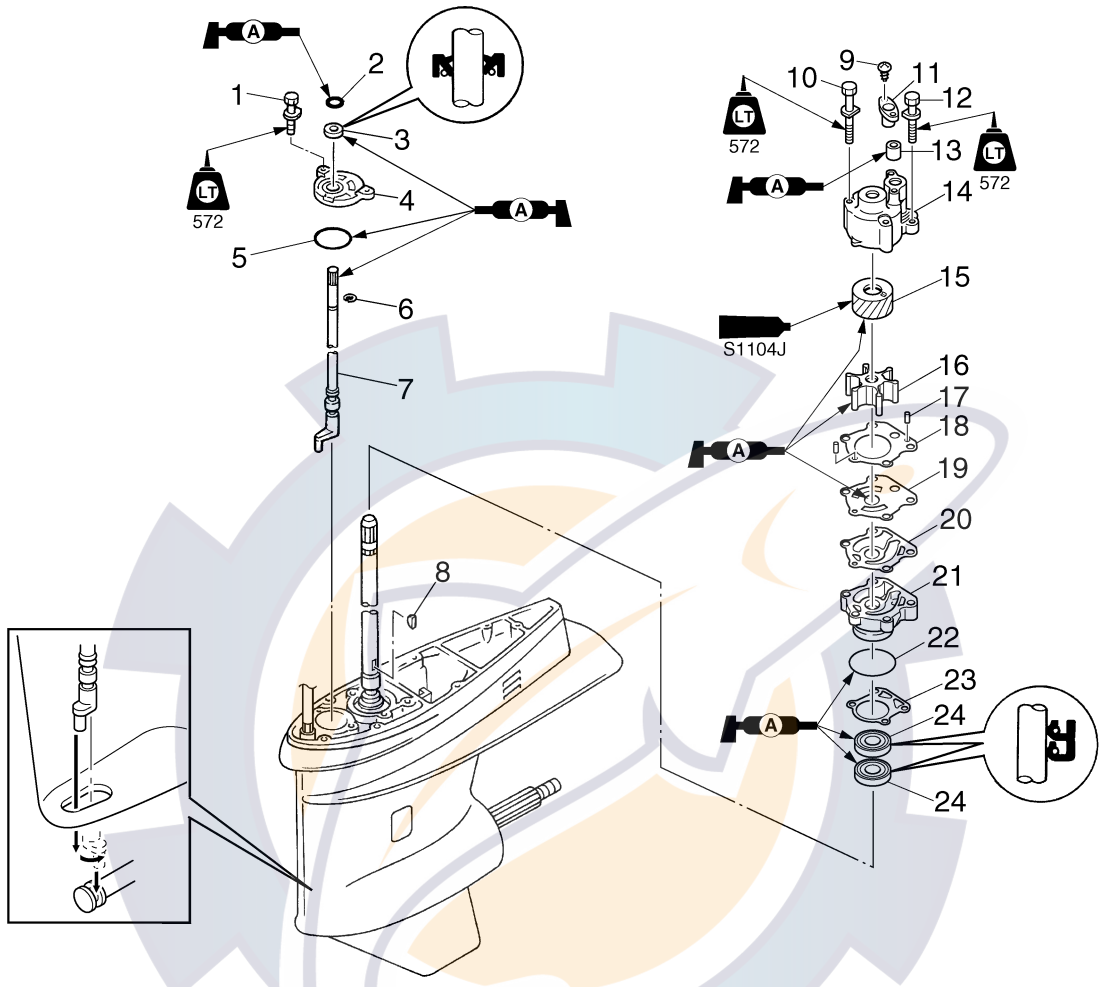

S6D86040

No.	Part name	Q'ty	Remarks
1	Bolt	2	M6 × 16 mm
2	O-ring	1	**Not reusable**
3	Oil seal	1	**Not reusable**
4	Oil seal housing	1	
5	O-ring	1	**Not reusable**
6	Circlip	1	
7	Shift rod	1	
8	Woodruff key	1	
9	Screw	2	ø4 × 12 mm
10	Bolt	2	M8 × 75 mm
11	Cover	1	
12	Bolt	2	M8 × 50 mm
13	Seal	1	
14	Water pump housing	1	
15	Insert cartridge	1	
16	Impeller	1	
17	Dowel	2	

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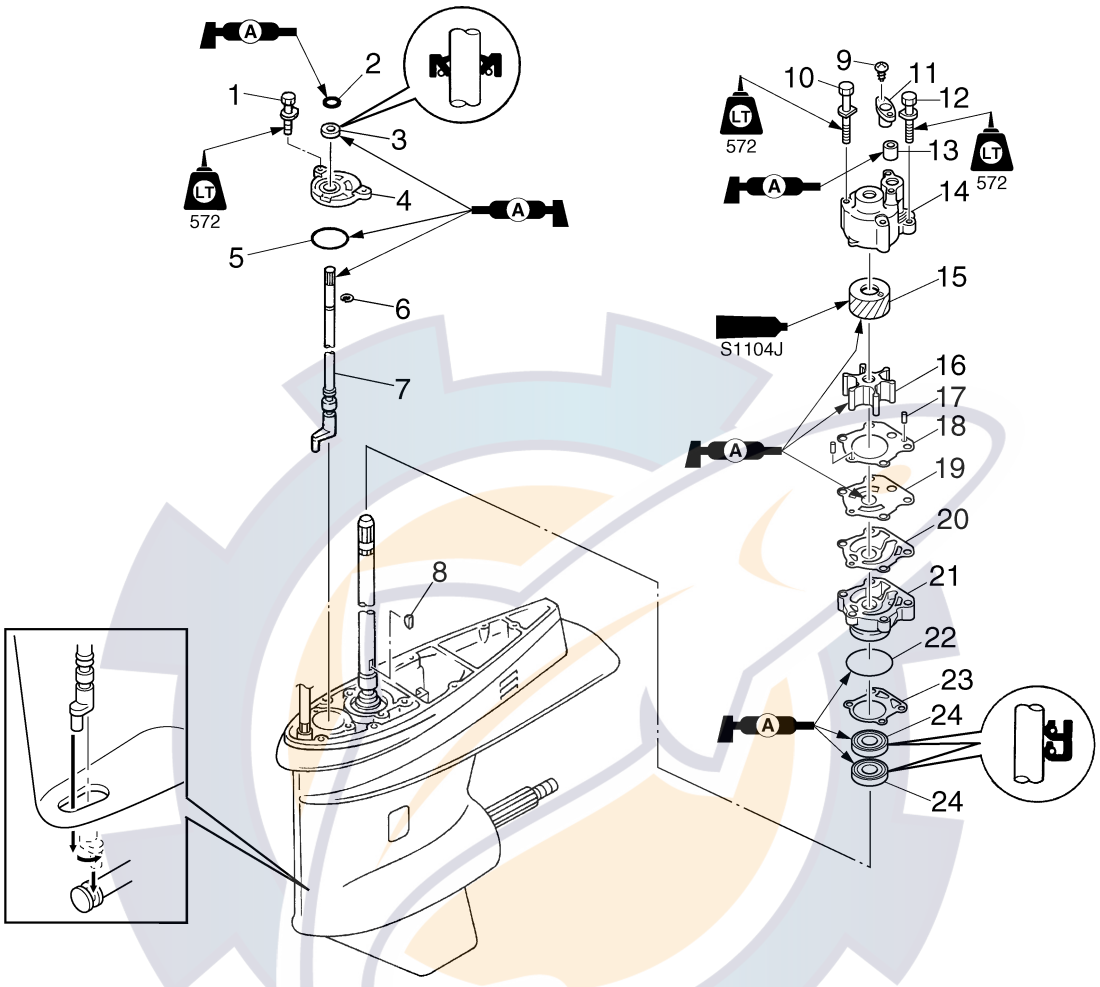

S6D86040

No.	Part name	Q'ty	Remarks
18	Gasket	1	Not reusable
19	Outer plate cartridge	1	
20	Gasket	1	Not reusable
21	Oil seal housing	1	
22	O-ring	1	Not reusable
23	Gasket	1	Not reusable
24	Oil seal	2	Not reusable

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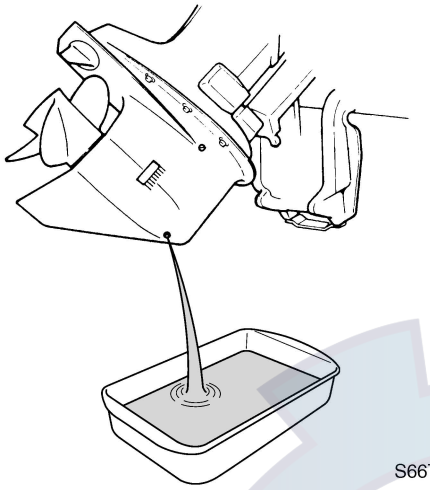
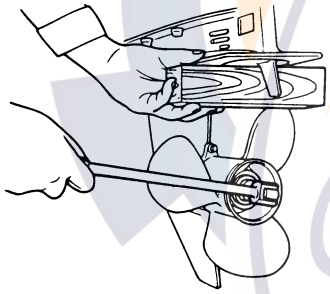
Removing the lower unit

1. Drain the gear oil.



S66T6370

2. Set the gear shift to the neutral position, and place a block of wood between the anti-cavitation plate and propeller to keep the propeller from turning, and then remove the propeller nut and propeller.



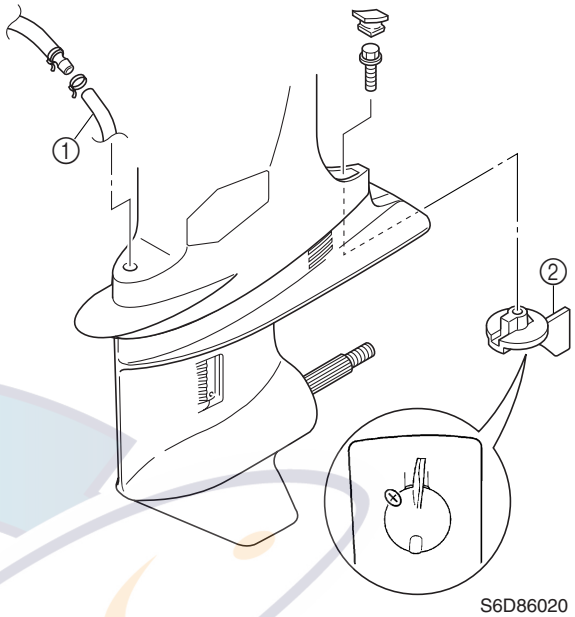
S62Y6485

⚠ WARNING

- **Do not hold the propeller with your hands when loosening or tightening it.**
- **Be sure to disconnect the battery leads from the battery and the clip from the engine stop lanyard switch.**
- **Put a block of wood between the anti-cavitation plate and propeller to keep the propeller from turning.**

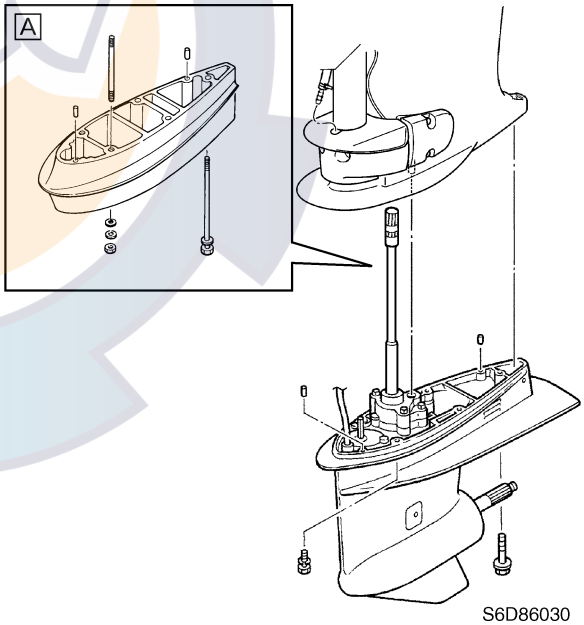
3. Disconnect the speedometer hose ①.

4. Mark the trim tab ② at the area shown, and then remove it.



S6D86020

5. Loosen the bolts (nuts), and then remove the lower unit from the upper case.



S6D86030

A X-transom model

6

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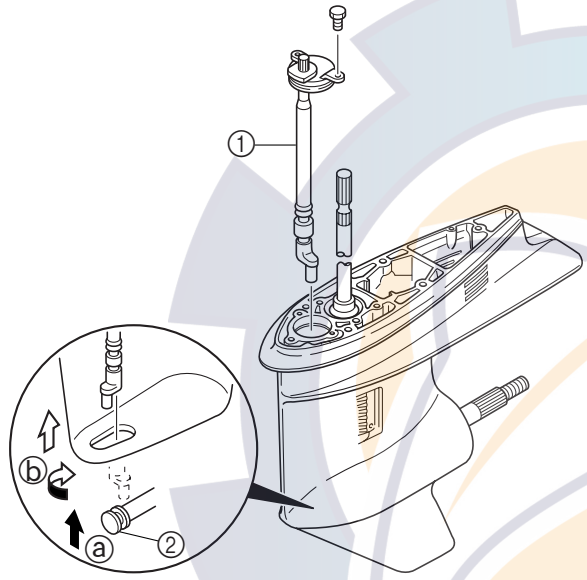
Removing the water pump and shift rod

1. Remove the water pump housing and impeller.
2. Remove the Woodruff key.
3. Remove the outer plate cartridge and oil seal housing.
4. Remove the shift rod assembly ①.

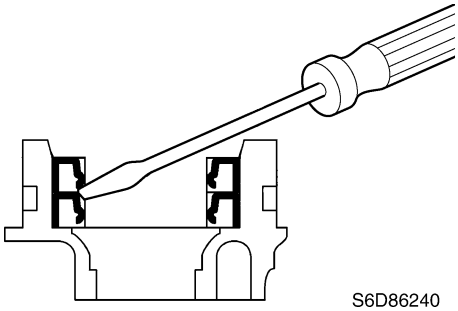


S60C6405

NOTE:
Pull up the shift rod assembly a little ⓐ to disconnect it from the shift slider ②, turn it clockwise 90° ⓑ, and then remove it.

Disassembling the oil seal housing

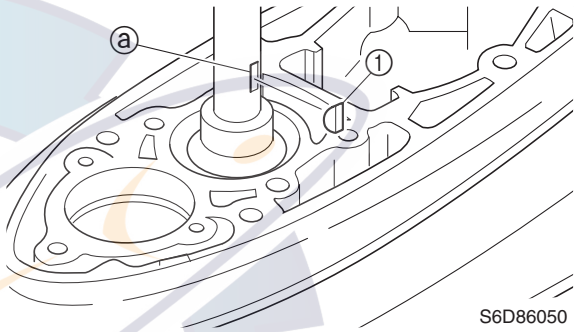
1. Remove the oil seals using a flat head screw driver.



S6D86240

Checking the water pump and shift rod

1. Check the water pump housing for deformation. Replace if necessary.
2. Check the impeller and insert cartridge for cracks or wear. Replace if necessary.
3. Check the Woodruff key ① and the groove ⓐ on the drive shaft for wear. Replace if necessary.



S6D86050

4. Check the shift rod for cracks or wear. Replace if necessary.

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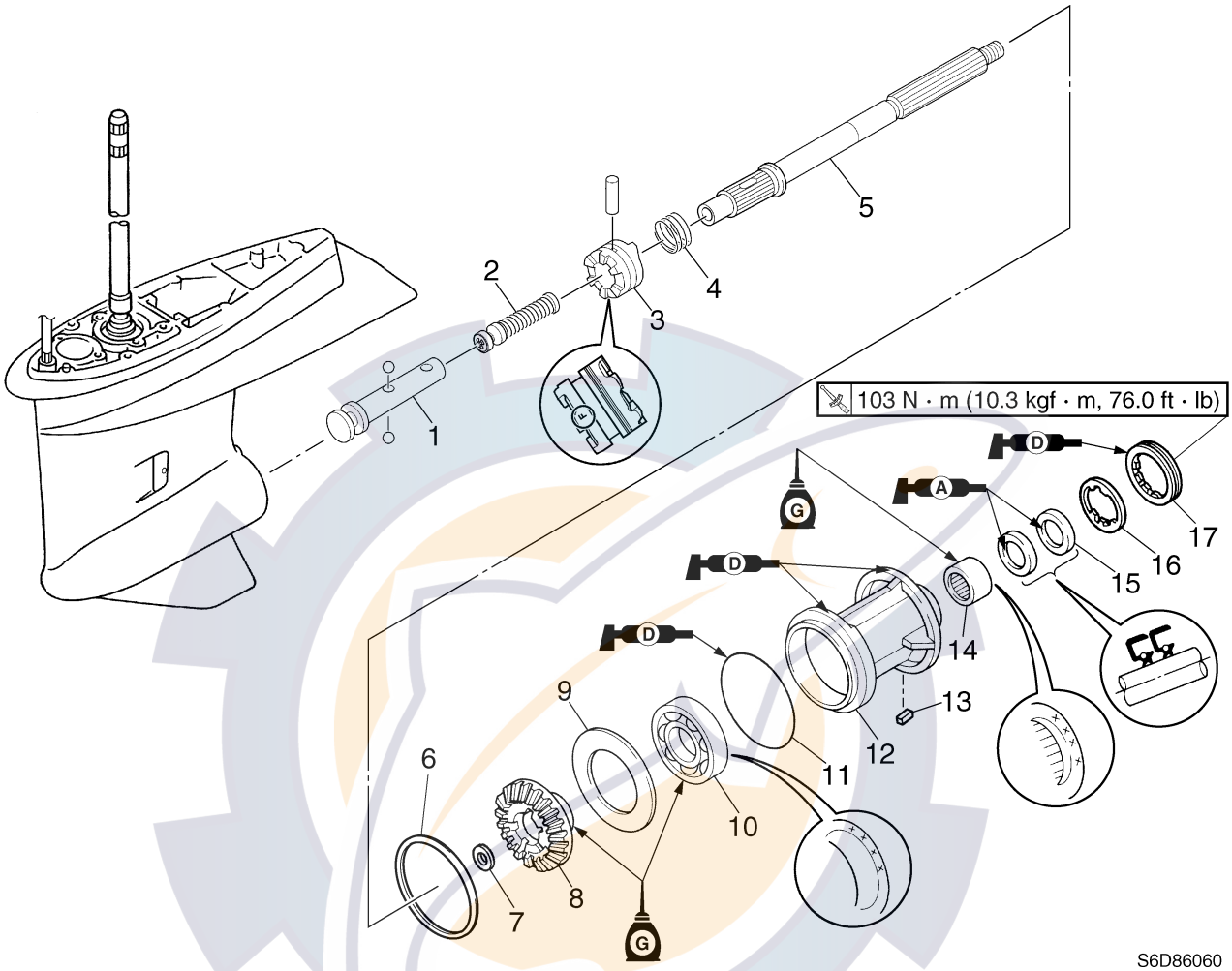
Propeller shaft housing



No.	Part name	Q'ty	Remarks
1	Slider	1	
2	Shift plunger	1	
3	Dog clutch	1	
4	Spring	1	
5	Propeller shaft	1	
6	Shim	1	0.3 mm
7	Washer	1	
8	Reverse gear	1	
9	Thrust washer	1	
10	Ball bearing	1	**Not reusable**
11	O-ring	1	**Not reusable**
12	Propeller shaft housing	1	
13	Straight key	1	
14	Needle bearing	1	
15	Oil seal	2	**Not reusable**
16	Claw washer	1	
17	Ring nut	1	

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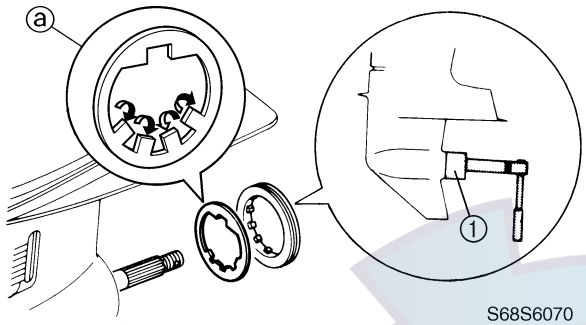
Removing the propeller shaft housing assembly

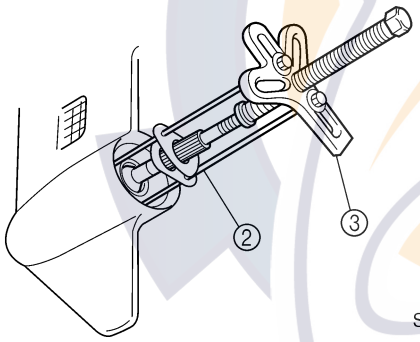
1. Straighten the claw washer tabs ⓐ, and then remove the ring nut and claw washer.



S68S6070

	Gland nut wrench ①: YB-34447

2. Pull out the propeller shaft housing assembly.



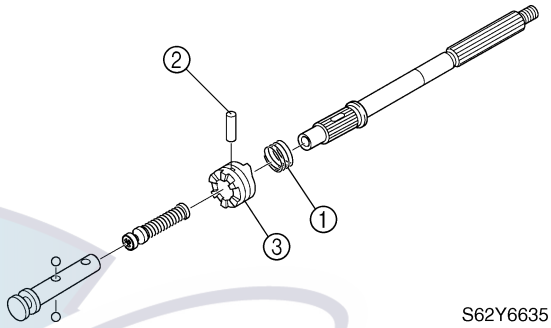
S68S6080

	Bearing housing puller ②: YB-06207 Universal puller ③: YB-06117

3. Remove the propeller shaft assembly.

Disassembling the propeller shaft assembly

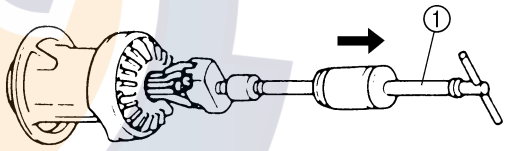
1. Remove the spring ①, and then remove the cross pin ②, dog clutch ③, slider and shift plunger.



S62Y6635

Disassembling the propeller shaft housing

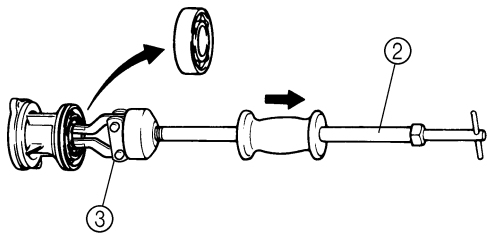
1. Remove the reverse gear and thrust washer.



S62Y6610

	Slide hammer ①: YB-06096

2. Remove the ball bearing.



S68S6090

CAUTION:

Do not reuse the bearing, always replace it with a new one.

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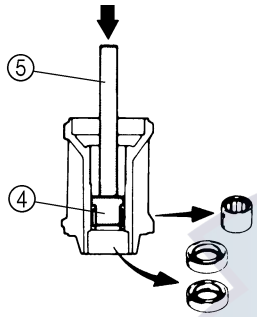
Slide hammer ②: YB-06096
Bearing puller legs ③: YB-06523

3. Remove the oil seals and needle bearing.



S68S6100

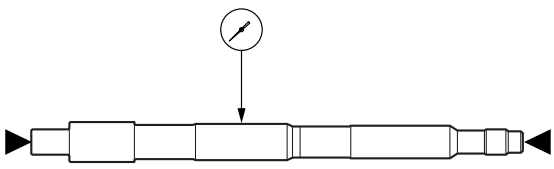
Bearing housing needle bearing remover ④:
YB-06153
Driver handle (large) ⑤: YB-06071

Checking the propeller shaft housing

1. Clean the propeller shaft housing using a soft brush and cleaning solvent, and then check it for cracks. Replace if necessary.
2. Check the teeth and dogs of the reverse gear for cracks or wear. Replace the gear if necessary.
3. Check the bearings for pitting or rumbling. Replace if necessary.

Checking the propeller shaft

1. Check the propeller shaft for bends or wear. Replace if necessary.
2. Measure the propeller shaft runout.



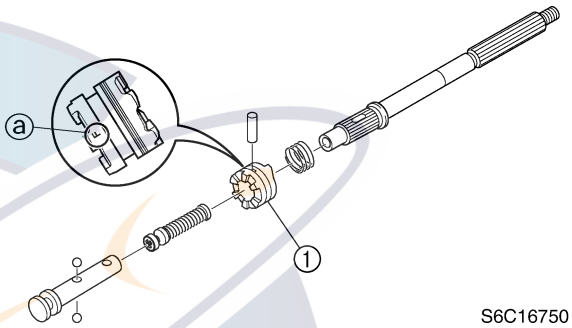
S6D56510

Runout limit: 0.02 mm (0.0008 in)

3. Check the dog clutch and slider for cracks or wear. Replace if necessary.

Assembling the propeller shaft assembly

1. Install the dog clutch as shown.



S6C16750

NOTE:
Install the dog clutch ① with the "F" mark ⓐ facing toward the slider.

6

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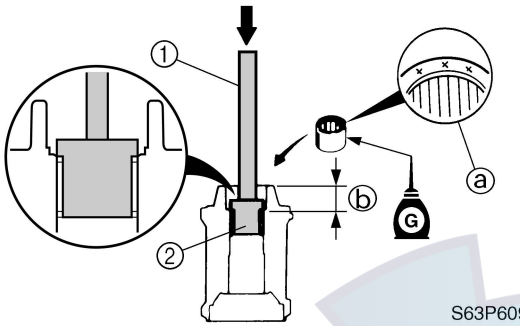
Assembling the propeller shaft housing

1. Install the needle bearing into the propeller shaft housing to the specified depth.



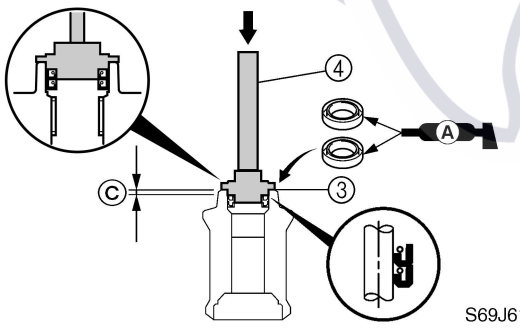
S63P6090

NOTE:
Install the needle bearing with the manufacture identification mark ⓐ facing toward the oil seal (propeller side).

Driver handle (large) ①: YB-06071
Bearing housing needle bearing remover ②:
YB-06153

Depth ⓑ:
25.25 ± 0.25 mm (0.99 ± 0.01 in)

2. Apply grease to the new oil seals, and then install them into the propeller shaft housing to the specified depth.



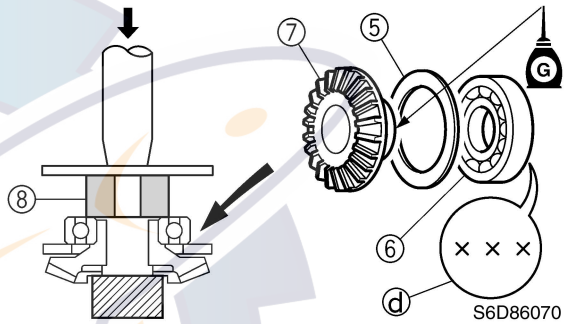
S69J6145

NOTE:
Install an oil seal halfway into the propeller shaft housing, then the other oil seal.

Propeller shaft oil seal installer ③:
YB-06269
Driver handle (large) ④: YB-06071

Depth ⓒ:
5.0 ± 0.5 mm (0.20 ± 0.02 in)

3. Install the thrust washer ⑤ and new ball bearing ⑥ to the reverse gear ⑦ using a press.



S6D86070

NOTE:
Install the ball bearing with the manufacture identification mark ⓓ facing outward (propeller side).

Drive shaft needle bearing depth stop ⑧:
YB-34473

4. Install the reverse gear assembly into the propeller shaft housing using a press.

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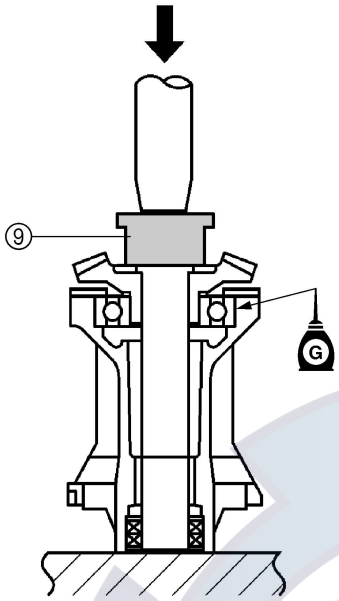
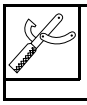


S6D86220

	Bearing outer race attachment ⑨: YB-06109

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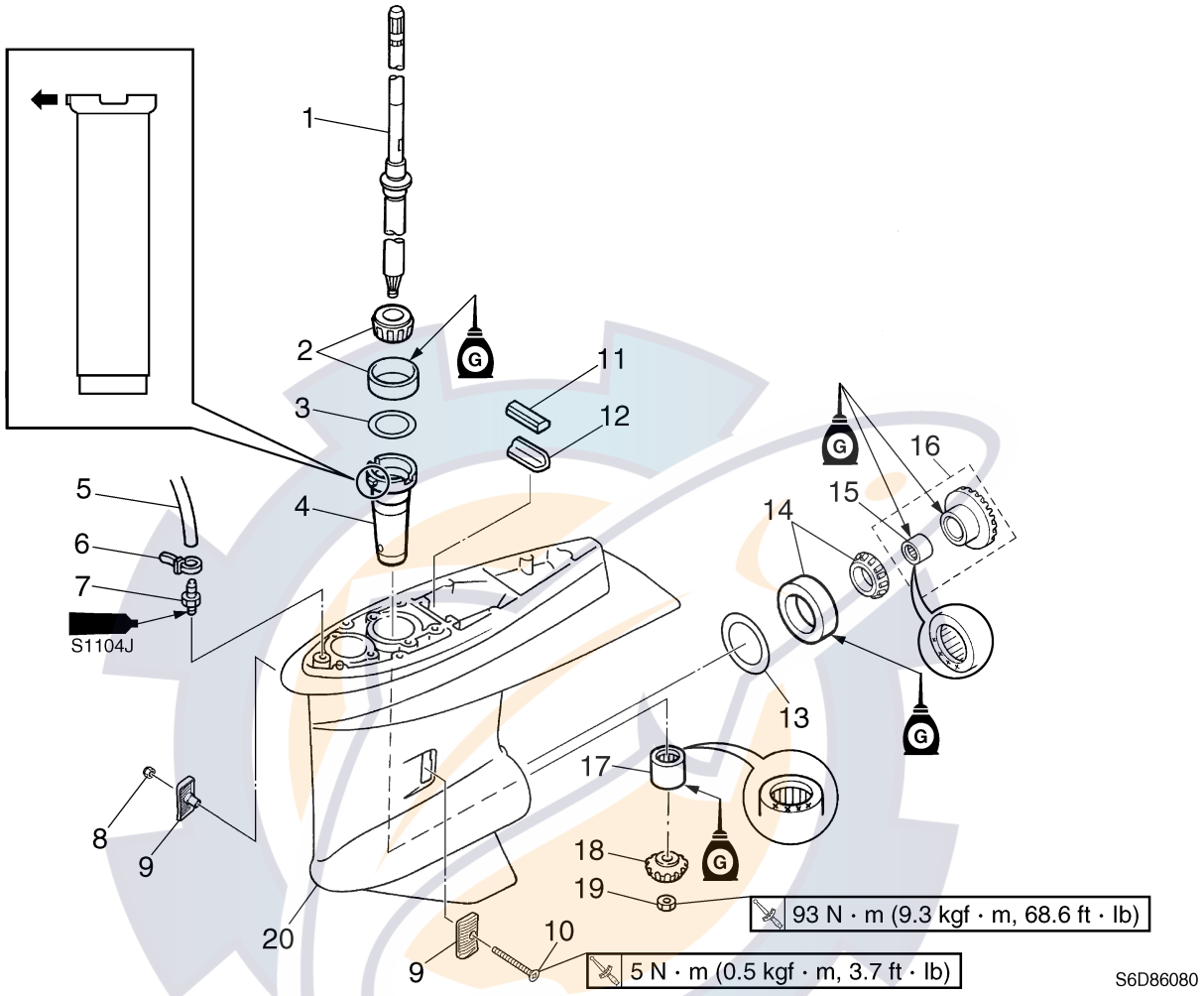
Drive shaft and lower case



No.	Part name	Q'ty	Remarks
1	Drive shaft	1	
2	Taper roller bearing	1	Not reusable
3	Pinion shim	—	
4	Sleeve	1	
5	Hose	1	
6	Plastic tie	1	Not reusable
7	Joint	1	
8	Nut	1	
9	Cooling water inlet cover	2	
10	Screw	1	ø5 × 40 mm
11	Seal	1	
12	Plate	1	
13	Forward gear shim	—	
14	Taper roller bearing	1	Not reusable
15	Needle bearing	1	Not reusable
16	Forward gear assembly	1	
17	Needle bearing	1	

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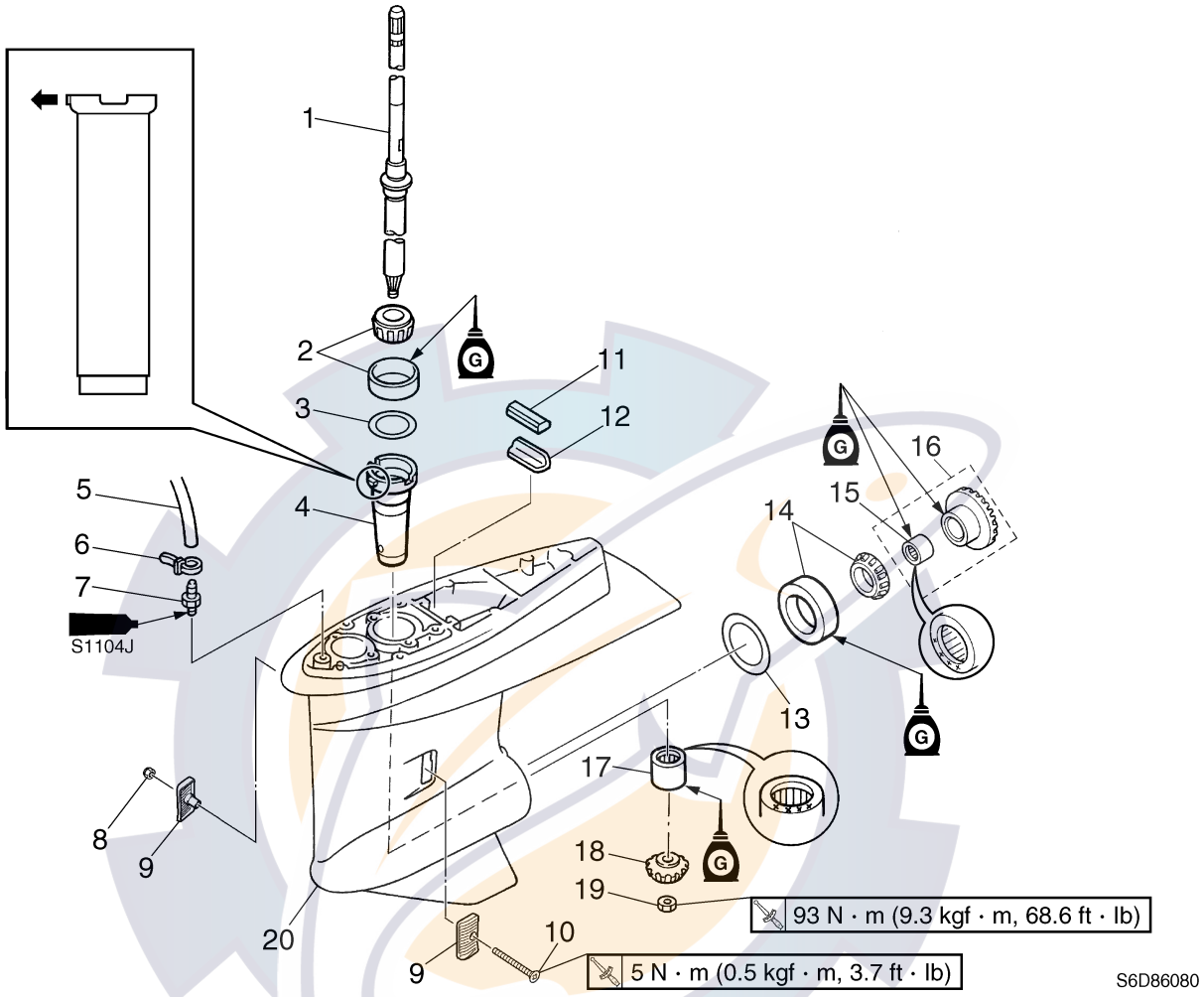

No.	Part name	Q'ty	Remarks
18	Pinion	1	
19	Nut	1	
20	Lower case	1	

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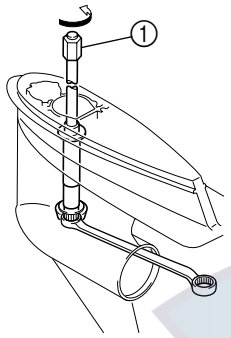
Removing the drive shaft

1. Remove the drive shaft assembly and pinion, and then pull out the forward gear.

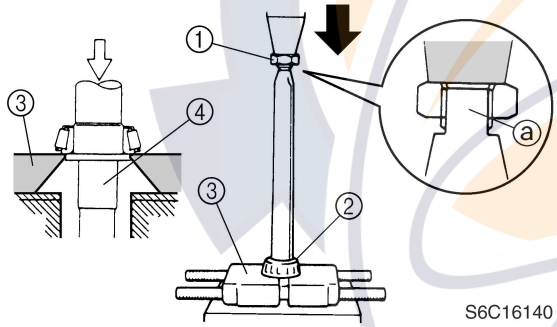


S68S6150

	Drive shaft holder ①: YB-06151

Disassembling the drive shaft

1. Install the pinion nut ①, tighten it finger tight, and then remove the drive shaft bearing ② using a press.



S6C16140

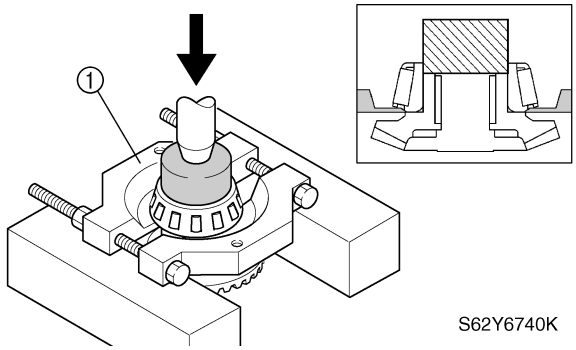
CAUTION:

- **Do not press the drive shaft threads ⓐ directly.**
- **When removing the drive shaft bearing, do not damage the drive shaft collar ④.**
- **Do not reuse the bearing, always replace it with a new one.**

	Bearing splitter plate ③: (commercially available)

Disassembling the forward gear

1. Remove the taper roller bearing from the forward gear using a press.



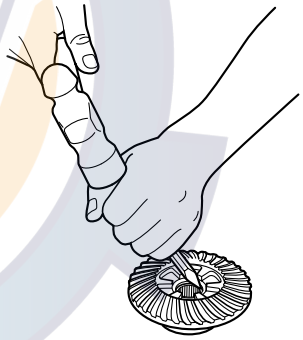
S62Y6740K

CAUTION:

Do not reuse the bearing, always replace it with a new one.

	Bearing splitter plate ①: (commercially available)

2. Remove the needle bearing from the forward gear.

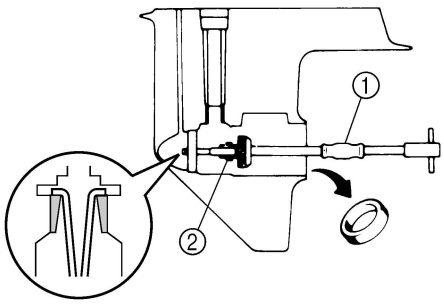

S68S6160

CAUTION:

Do not reuse the bearing, always replace it with a new one.

Disassembling the lower case

1. Remove the taper roller bearing outer race and shim(s).



S6C16700

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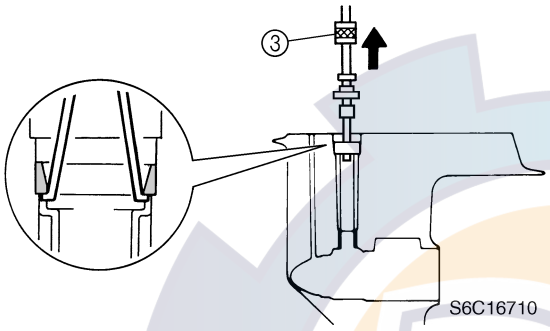
NOTE:
Install the claws as shown.

Slide hammer ①: YB-06096
Bearing puller legs ②: YB-06523

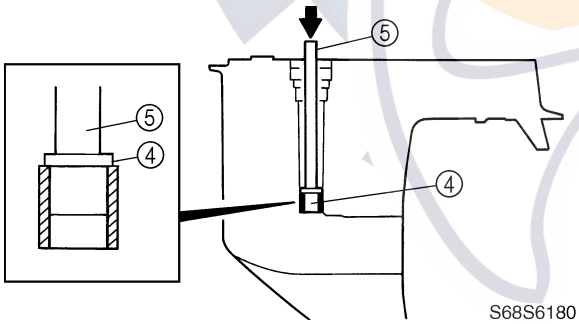
2. Remove the drive shaft bearing outer race, shim(s), and drive shaft sleeve.



NOTE:
Install the claws as shown.

Slide hammer ③: YB-06096

3. Remove the needle bearing.



Drive shaft needle bearing remover and installer ④:
YB-06155
Driver handle (large) ⑤: YB-06071

Checking the pinion and forward gear

1. Check the teeth of the pinion, and the teeth and dogs of the forward gear for cracks or wear. Replace if necessary.

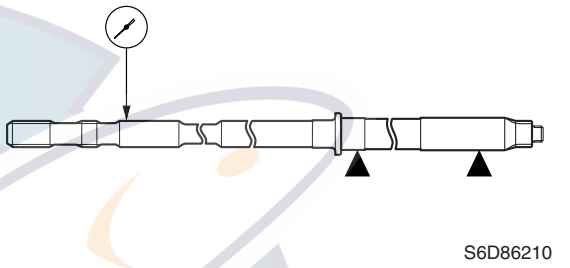
Checking the bearings

1. Check the bearings for pitting or rumbling. Replace if necessary.

Checking the drive shaft

1. Check the drive shaft for bends or wear. Replace if necessary.

2. Measure the drive shaft runout.



Runout limit: 0.5 mm (0.020 in)

Checking the lower case

1. Check the skeg and torpedo for cracks or damage. Replace the lower case if necessary.

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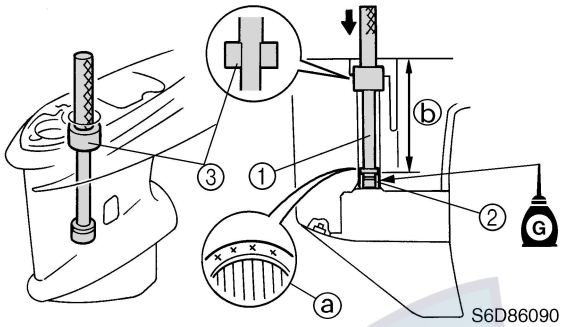
Assembling the lower case

1. Install the needle bearing into the lower case to the specified depth.

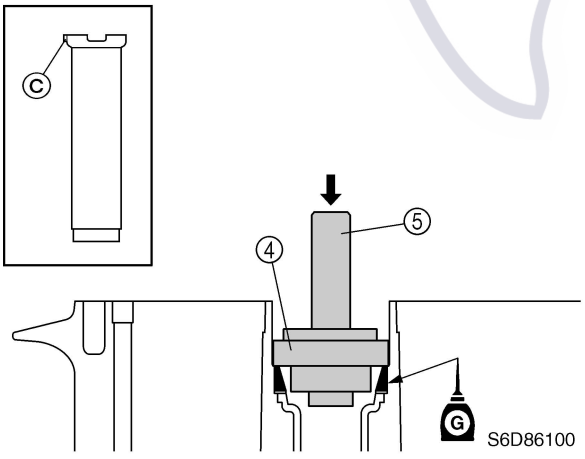


NOTE:
Install the needle bearing with the manufacture identification mark ⓐ facing upward.

Driver handle (large) ①: YB-06071
Drive shaft needle bearing remover and installer ②:
YB-06155
Drive shaft needle bearing depth stop ③:
YB-34473

Depth ⓑ:
188.1 ± 0.5 mm (7.41 ± 0.02 in)

2. Install the sleeve, original shim(s), and taper roller bearing outer race.

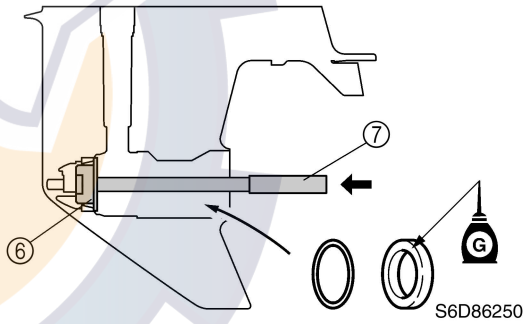


CAUTION:
Add or remove shim(s), if necessary, if replacing the taper roller bearing or lower case.

NOTE:
- Apply the gear oil to the inside and outside of the sleeve before installation.
- Install the sleeve by facing the projection ⓒ forward.

Drive shaft seal installer ④:
YB-06244
Driver handle (large) ⑤: YB-06071

3. Install the original shim(s) and taper roller bearing outer race.



CAUTION:
Add or remove shim(s), if necessary, if replacing the taper roller bearing or lower case.

Forward gear bearing cup installer ⑥:
YB-06276-B
Driver handle (large) ⑦: YB-06071

Assembling the forward gear

1. Install a new taper roller bearing into the forward gear using a press.

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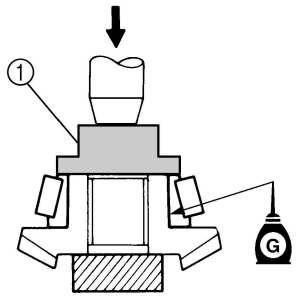
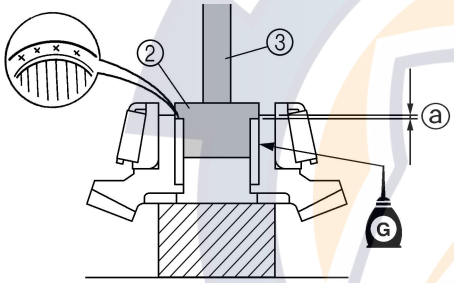


S6C16530

	Forward gear outer race installer ①: YB-06085

2. Install a new needle bearing into the forward gear to the specified depth.



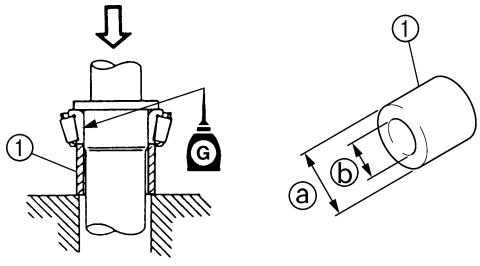
S6C16540

	Bearing housing needle bearing remover ①: YB-06112 Driver handle (large) ②: YB-06071

	Depth ⓐ: 1.20 ± 0.25 mm (0.05 ± 0.01 in)

Assembling the drive shaft

1. Install a new drive shaft bearing into the drive shaft using a press.

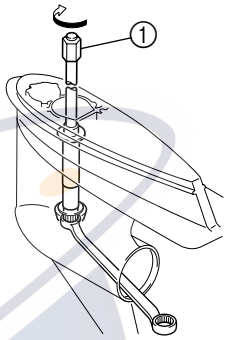


S6C16270

	General pipe ①: ⓐ = 33 mm (1.30 in) ⓑ = 28 mm (1.10 in)

Installing the drive shaft

1. Install the forward gear, then the drive shaft assembly, pinion, and pinion nut, and then tighten the nut to the specified torque.



S68S6410

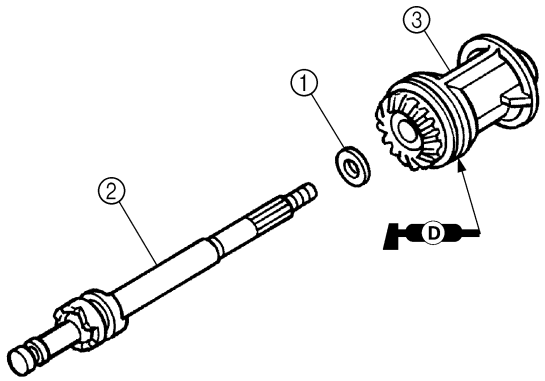
	Drive shaft holder ①: YB-06151

	Pinion nut: 93 N·m (9.3 kgf·m, 68.6 ft·lb)

Installing the propeller shaft housing

1. Install the washer ① and propeller shaft assembly ② into the propeller shaft housing assembly ③.

2. Apply grease to a new O-ring.



S62Y6705

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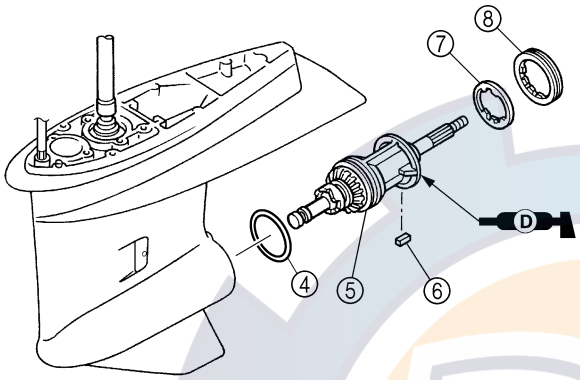
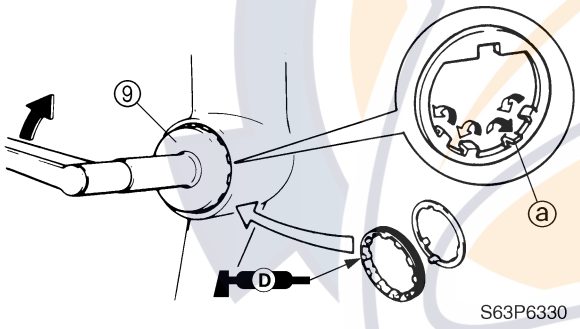
3. Install the shim ④ and propeller shaft housing assembly ⑤ into the lower case, and then install the straight key ⑥, claw washer ⑦, and ring nut ⑧.

4. Tighten the ring nut to the specified torque.



S63P6320



S63P6330

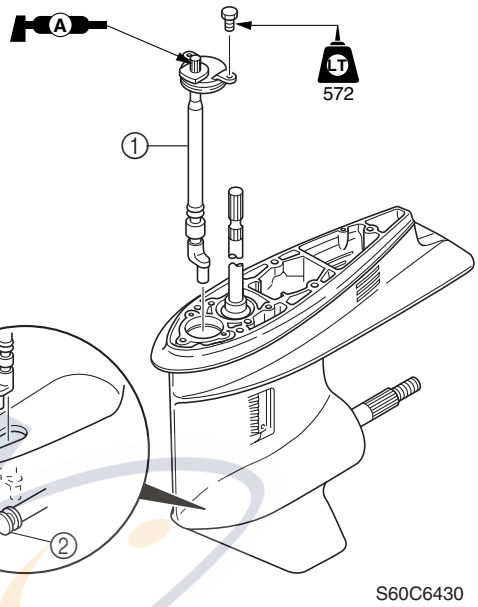
NOTE:
- To secure the ring nut, bend one tab ⓐ of the claw washer into a slot in the ring nut.
- Bend all other tabs toward the propeller shaft housing assembly.

	Gland nut wrench ⑨: YB-34447

	Ring nut ⑧: 103 N·m (10.3 kgf·m, 76.0 ft·lb)

Installing the water pump and shift rod

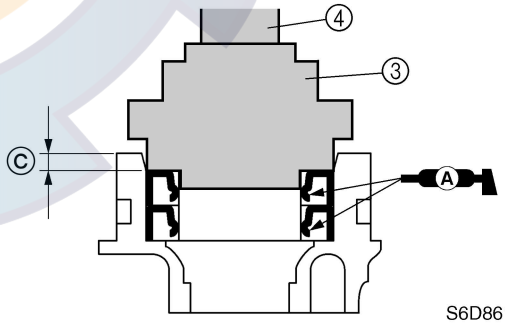
1. Install the shift rod assembly ①.



S60C6430

NOTE:
Install the shift rod assembly into the lower case, turn it counterclockwise 90° ⓐ, and then push it down ⓑ to connect it to the shift slider ②.

2. Install new oil seals into the oil seal housing as shown.



S6D86130

NOTE:
Install an oil seal halfway into the oil seal housing, then the other oil seal.

	Propeller shaft oil seal installer ③: YB-06269 Driver handle (large) ④: YB-06071

	Depth ⓒ: 4.0 ± 0.5 mm (0.16 ± 0.02 in)

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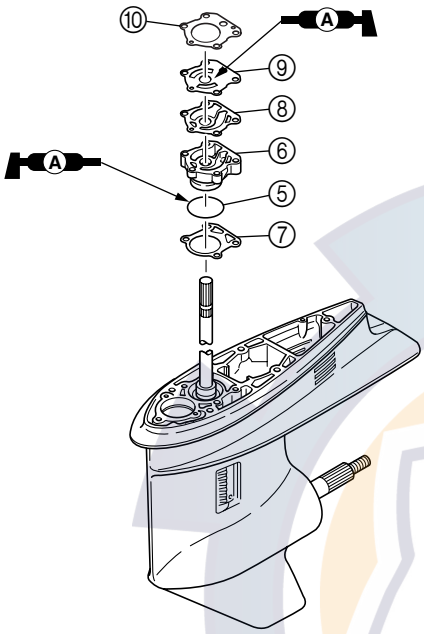
3. Install a new O-ring ⑤ onto the oil seal housing ⑥.

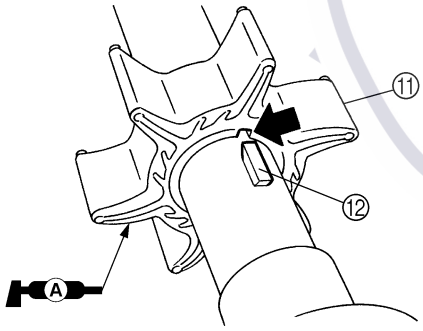
4. Install a new gasket ⑦, the oil seal housing ⑥, a new gasket ⑧, the outer plate cartridge ⑨, and a new gasket ⑩.



S6D86140

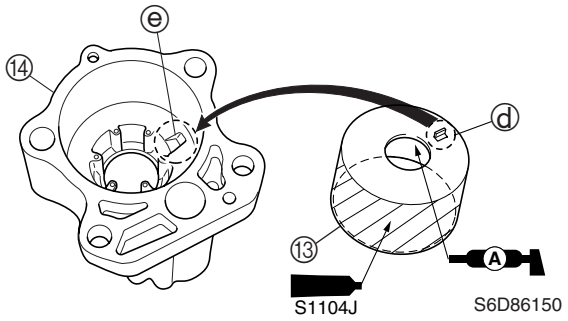
5. Install the Woodruff key into the drive shaft.

6. Align the groove on the impeller ⑪ with the Woodruff key ⑫, and then install the impeller onto the drive shaft.



S6D86260

7. Install the insert cartridge ⑬ into the water pump housing ⑭.

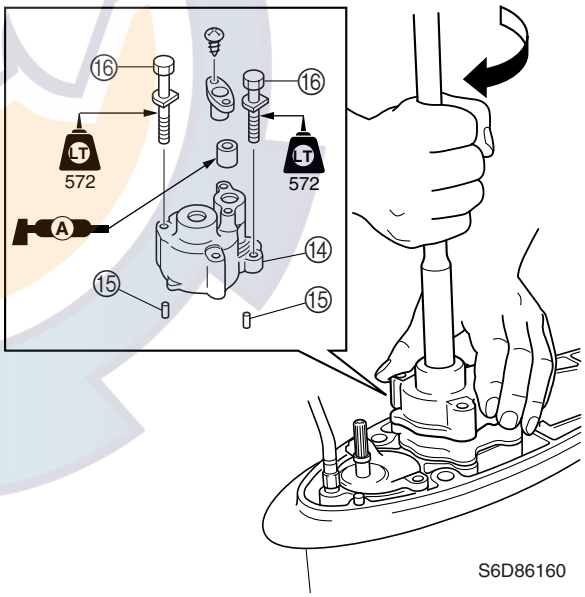


S6D86150

NOTE:
Align the insert cartridge projection ⓓ with the hole ⓔ in the water pump housing.

8. Install the dowels ⑮, and the water pump housing ⑭ onto the lower case.

9. Install and tighten the bolts ⑯.



S6D86160

NOTE:
- Apply grease to the inside of the water pump housing before installation.
- To install the water pump housing, push down on the pump housing, and then turn the drive shaft clockwise.

Installing the lower unit

1. Set the gear shift to the neutral position at the lower unit.

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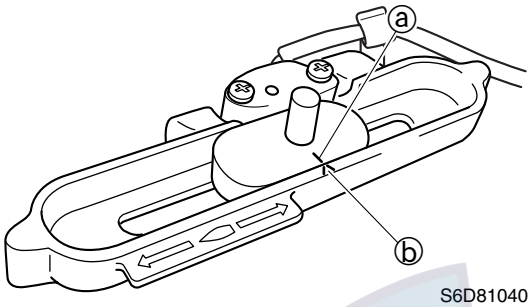
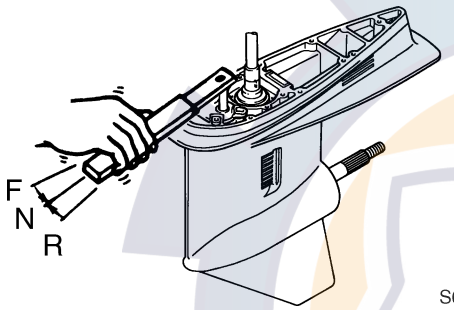
2. Align the alignment mark ⓐ on the bushing with the alignment mark ⓑ on the bracket.



S6D81040

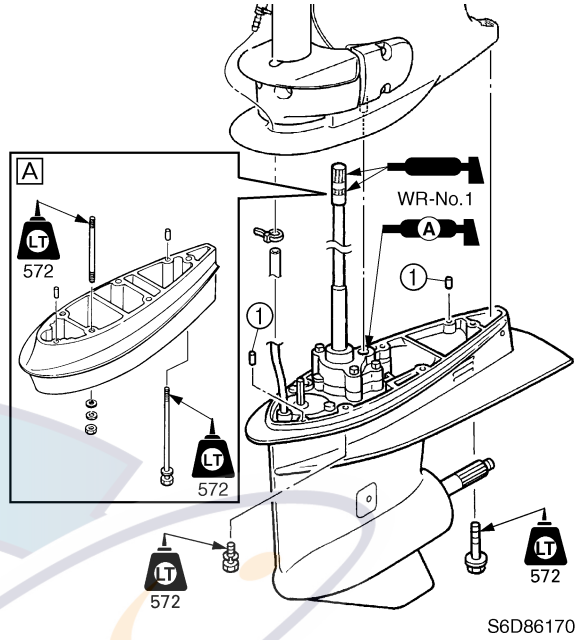


S6D86190

Shift rod push arm: YB-06052

3. Install the dowels ① into the lower unit.

4. Install the lower unit into the upper case, and then tighten the lower case mounting bolts (nuts) to the specified torque.

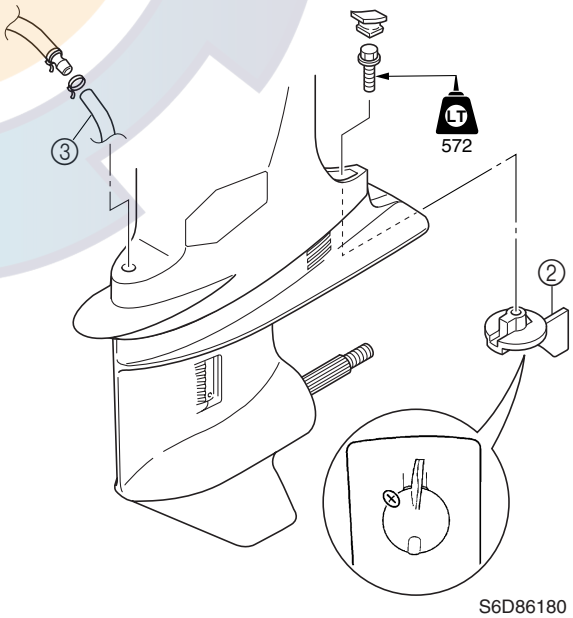


S6D86170

A X-transom model

Lower case mounting bolt (nut):
39 N·m (3.9 kgf·m, 28.8 ft·lb)

5. Install the trim tab ② to its original position, and then connect the speedometer hose ③.



S6D86180

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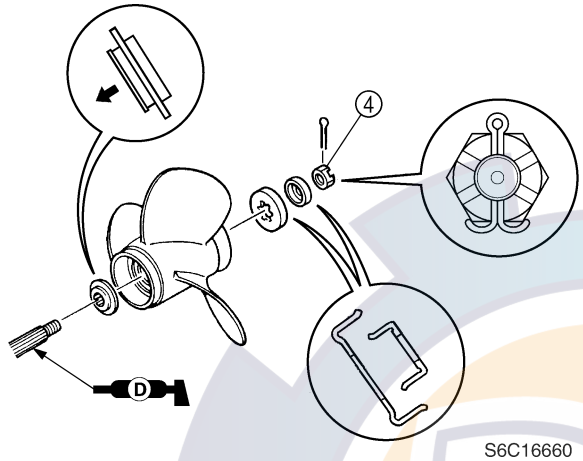
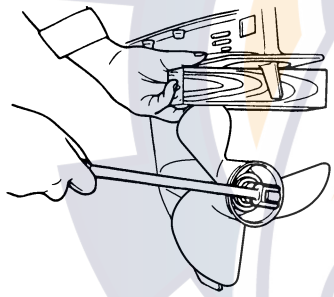
6. Install the propeller and propeller nut, and then tighten the nut finger tight. Place a block of wood between the anti-cavitation plate and propeller to keep the propeller from turning, and then tighten the nut to the specified torque.



S6C16660



S69J6340

⚠ WARNING

- **Do not hold the propeller with your hands when loosening or tightening it.**
- **Be sure to disconnect the battery leads from the battery and the clip from the engine stop lanyard switch.**
- **Put a block of wood between the anti-cavitation plate and propeller to keep the propeller from turning.**

NOTE:

If the grooves in the propeller nut ④ do not align with the cotter pin hole, tighten the nut until they are aligned.

	Propeller nut ④: 34 N·m (3.4 kgf·m, 25.1 ft·lb)

7. Fill the gear oil to the correct level.

6

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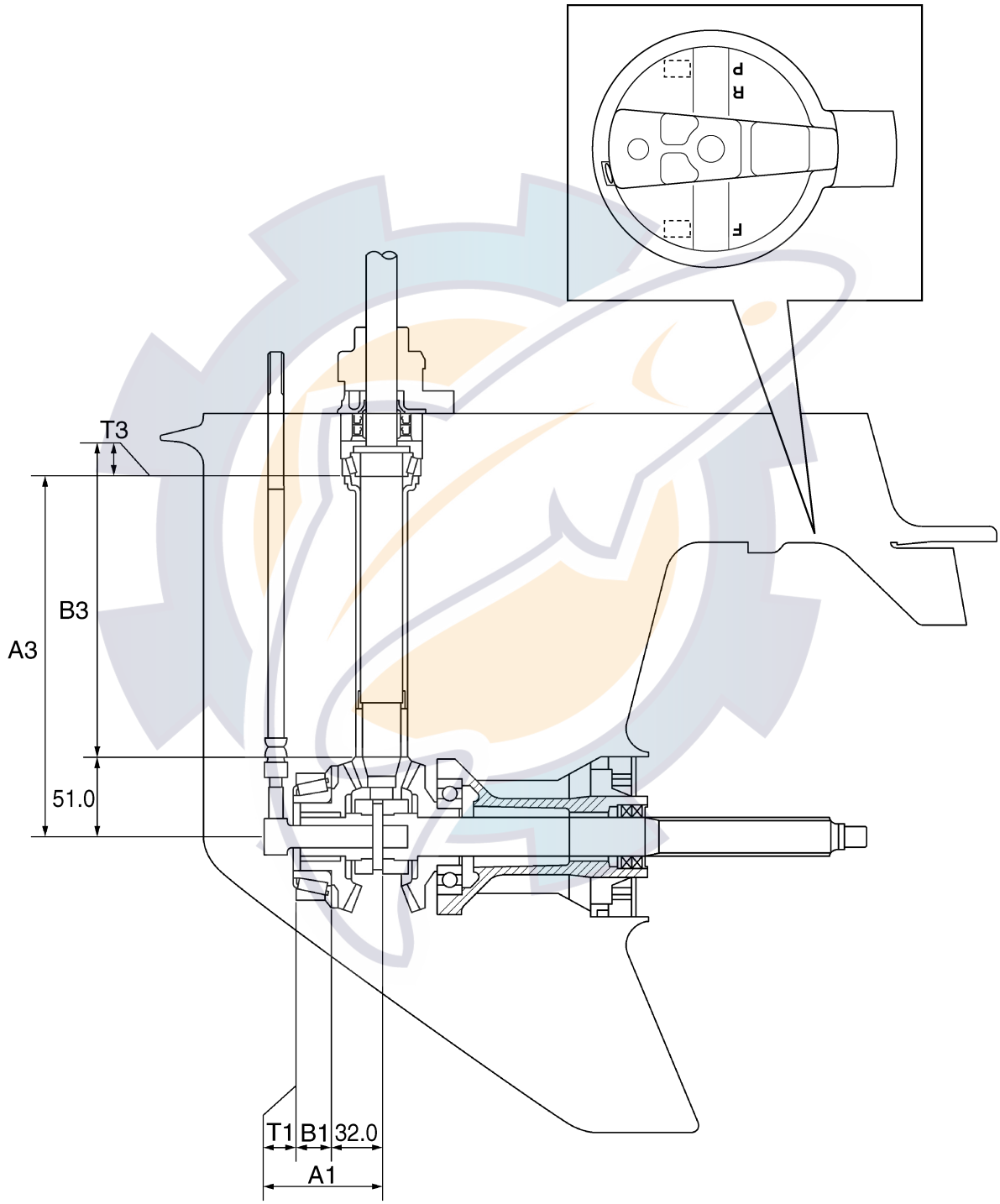
Shimming



S6C16670

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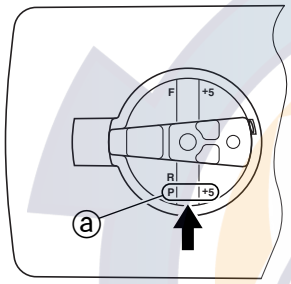
Shimming

NOTE:
- Shimming is not required when assembling the original lower case and inner parts.
- Shimming is required when assembling the original inner parts and a new lower case.
- Shimming is required when replacing the inner part(s).

Selecting the pinion shims

1. Calculate the specified value (M0) as shown in the examples below.



S68S6250

NOTE:
"P" is the deviation of the lower case dimension from standard. The "P" mark ⓐ is stamped on the trim tab mounting surface of the lower case in 0.01 mm units. If the "P" mark unreadable, assume that "P" is zero and check the backlash when the unit is assembled.

Specified value (M0) = 0.20 + P/100 mm

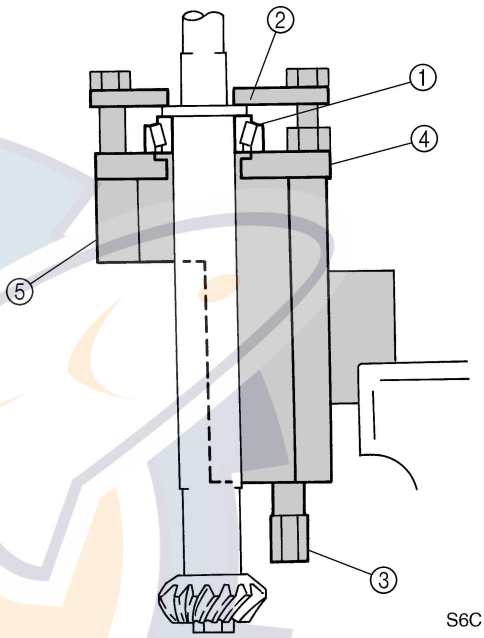
Example:
If "P" is "+5", then
M0 = 0.20 + (+5)/100 mm = 0.20 + 0.05 mm
= 0.25 mm
If "P" is "–5", then
M0 = 0.20 + (–5)/100 mm = 0.20 – 0.05 mm
= 0.15 mm

2. Install the drive shaft and drive shaft bearing ① to the special service tools.

3. Attach the clamp ② to the gauge base using the bolts of an appropriate size.

NOTE:
Tighten the clamp bolts another 1/4 of a turn after they contact the clamp ②.

4. Install the pinion and pinion nut, and then tighten the nut to the specified torque.



S6C16730

NOTE:
Install the special service tools onto the drive shaft so that the shaft is at the center of the hole.

	Pinion shim selecting tool: YB-34432-9 ③, YB-34432-10A ④, YB-34432-11A ⑤, YB-34432-17 ②

	Pinion nut: 93 N·m (9.3 kgf·m, 68.6 ft·lb)

6

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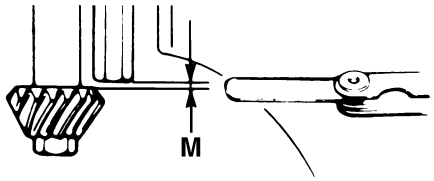
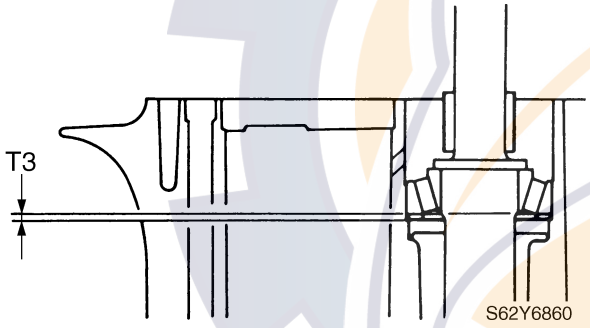
5. Measure the clearance (M) between the shim selecting tool and the pinion as shown.



S62Y6875

NOTE:
Measure the pinion at three points to find the clearance average.

6. Select the pinion shims (T3).



S62Y6860

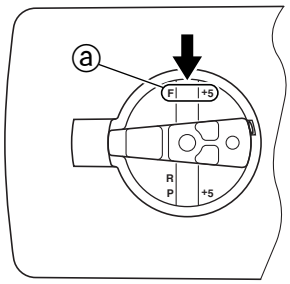
NOTE:
The sum of T3 and M0 should be more than M.

Calculation formula:
Pinion shim thickness (T3) = M – M0

Available shim thicknesses:
0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and 0.50 mm

Selecting the forward gear shims

1. Calculate the specified value (M0) as shown in the examples below.



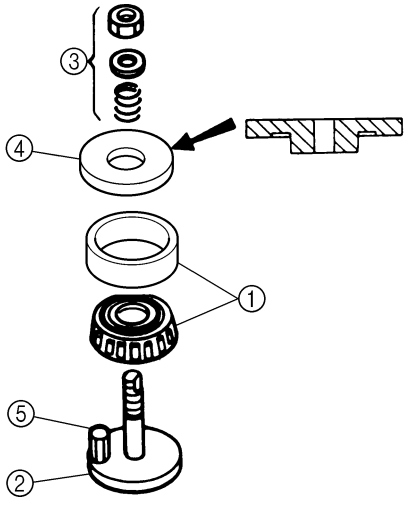
S68S6260

NOTE:
"F" is the deviation of the lower case dimension from standard. The "F" mark ⓐ is stamped on the trim tab mounting surface of the lower case in 0.01 mm units. If the "F" mark is unreadable, assume that "F" is zero and check the backlash when the unit is assembled.

Specified value (M0) = 1.61 + F/100 mm

Example:
If "F" is "+5", then
M0 = 1.61 + (+5)/100 mm = 1.61 + 0.05 mm
= 1.66 mm
If "F" is "–5", then
M0 = 1.61 + (–5)/100 mm = 1.61 – 0.05 mm
= 1.56 mm

2. Install the taper roller bearing ① onto the special service tools.



S62Y6890

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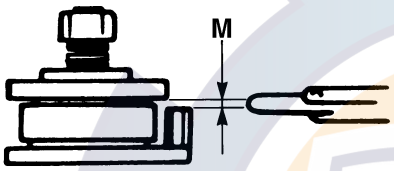
NOTE:
Tighten the nut four turns after it contacts the spring.

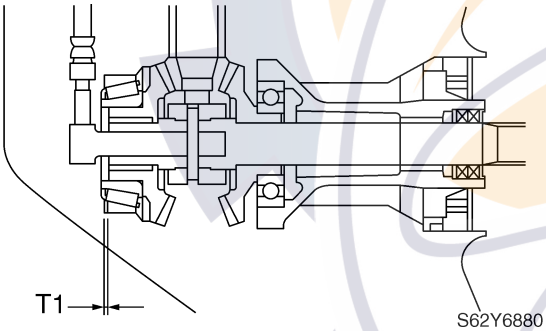
Forward gear shim selecting tool:
YB-34446-1 ②, YB-34446-3 ③,
YB-34446-5 ④, YB-34446-7 ⑤

3. Measure the clearance (M) between the gauge pin and the press plate.



S62Y6895

4. Select the forward gear shims (T1).



S62Y6880

NOTE:
The sum of T1 and M should not be more than M0.

Calculation formula:
Forward gear shim thickness (T1) =
M0 – M

Available shim thicknesses:
0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and 0.50 mm

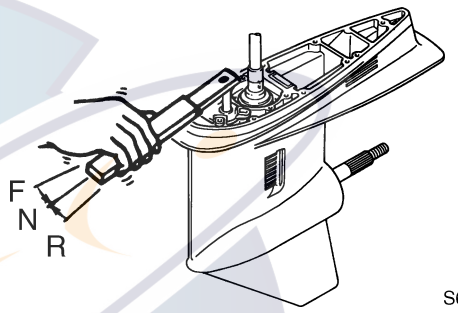
Backlash

Measuring the forward gear backlash

1. Remove the water pump assembly.

NOTE:
Do not remove the oil seal housing in this procedure.

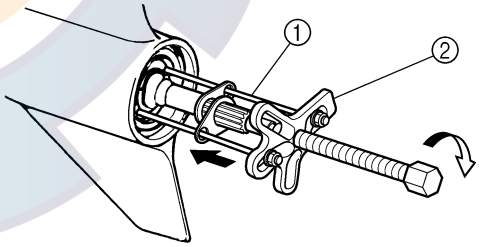
2. Set the gear shift to the neutral position at the lower unit.



S6D86190

Shift rod push arm: YB-06052

3. Install the special service tools so that it pushes against the propeller shaft.



S60X6390

NOTE:
Tighten the universal puller while turning the drive shaft until the drive shaft can no longer be turned.

Bearing housing puller ①:
YB-06207
Universal puller ②: YB-06117

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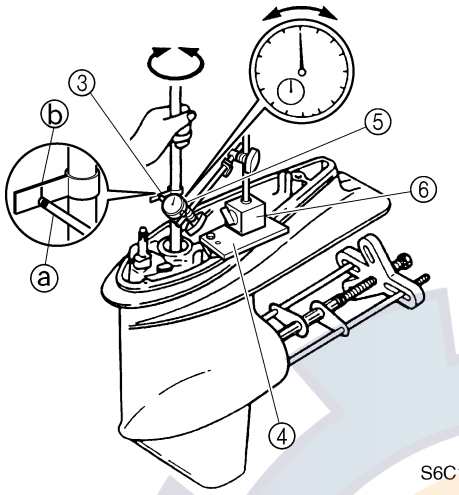
4. Install the backlash indicator onto the drive shaft (20 mm [0.79 in] in diameter), then the dial gauge onto the lower unit.



S6C16550

NOTE:
Install the dial gauge so that the plunger ⓐ contacts the mark ⓑ on the backlash indicator.

Backlash indicator rod ③:
YB-06265
Backlash adjustment plate ④:
YB-07003
Dial indicator gauge ⑤: YU-03097
Magnetic base stand ⑥: YU-A8438

5. Slowly turn the drive shaft clockwise and counterclockwise and measure the backlash when the drive shaft stops in each direction.

Forward gear backlash:
0.28–0.63 mm (0.0110–0.0248 in)

6. Add or remove shim(s) if out of specification.

Forward gear backlash	Shim thickness
Less than 0.28 mm (0.0110 in)	To be decreased by (0.46 – M) × 0.56
More than 0.63 mm (0.0248 in)	To be increased by (M – 0.46) × 0.56

M: Measurement

Available shim thicknesses:
0.10, 0.12, 0.15, 0.18, 0.30, 0.40, and 0.50 mm

7. Remove the special service tools, and then install the water pump assembly.

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Bracket unit

Special service tools **7-1**

Shift rod **7-2**

Bottom cowling **7-3**

Upper case **7-6**
Removing the upper case 7-12
Disassembling the oil pump 7-12
Checking the oil pump 7-12
Assembling the oil pump 7-12
Disassembling the upper case 7-13
Checking the drive shaft bushing 7-13
Disassembling the oil pan 7-13
Checking the oil strainer 7-14
Assembling the oil pan 7-14
Assembling the upper case 7-15
Installing the upper case 7-15

Steering arm **7-17**
Removing the steering arm 7-18
Installing the steering arm 7-18

Clamp brackets and swivel bracket **7-19**
Removing the clamp brackets 7-21
Installing the clamp brackets 7-21
Adjusting the trim sensor 7-21

Power trim and tilt unit **7-23**
Removing the power trim and tilt unit 7-24

Power trim and tilt motor **7-25**
Disassembling the power trim and tilt motor 7-27
Checking the power trim and tilt motor 7-27
Assembling the power trim and tilt motor 7-29

Gear pump **7-30**
Disassembling the gear pump 7-33
Checking the gear pump 7-33
Assembling the gear pump 7-33

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Tilt cylinder and trim cylinder 7-35
Disassembling the trim cylinder 7-38
Disassembling the tilt cylinder 7-38
Checking the tilt cylinder and trim cylinder 7-39
Checking the valves 7-39
Assembling the tilt cylinder 7-39
Assembling the power trim and tilt unit 7-41
Bleeding the power trim and tilt unit 7-43
Installing the power trim and tilt unit 7-44
Bleeding the power trim and tilt unit (built-in) 7-44

Power trim and tilt electrical system 7-45
Checking the fuse 7-45
Checking the power trim and tilt relay 7-45
Checking the power trim and tilt switch 7-46
Checking the trim sensor 7-46

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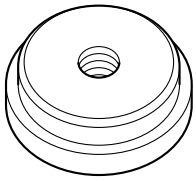
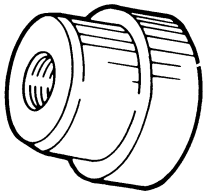
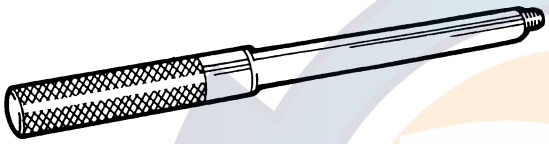
Special service tools



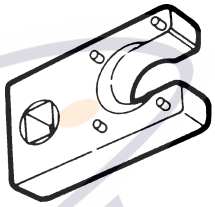
Bearing installer
YB-41446
Bearing cup installer
YB-06167



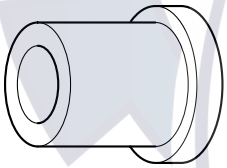
Drive shaft needle bearing installer and remover
YB-06196



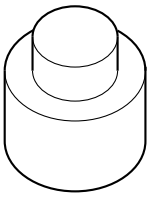
Driver handle (large)
YB-06071
Driver handle (small)
YB-06229



Trim cylinder wrench
YB-06175-2B



Roller bearing installer/remover
YB-06432



Oil seal installer
YB-06023

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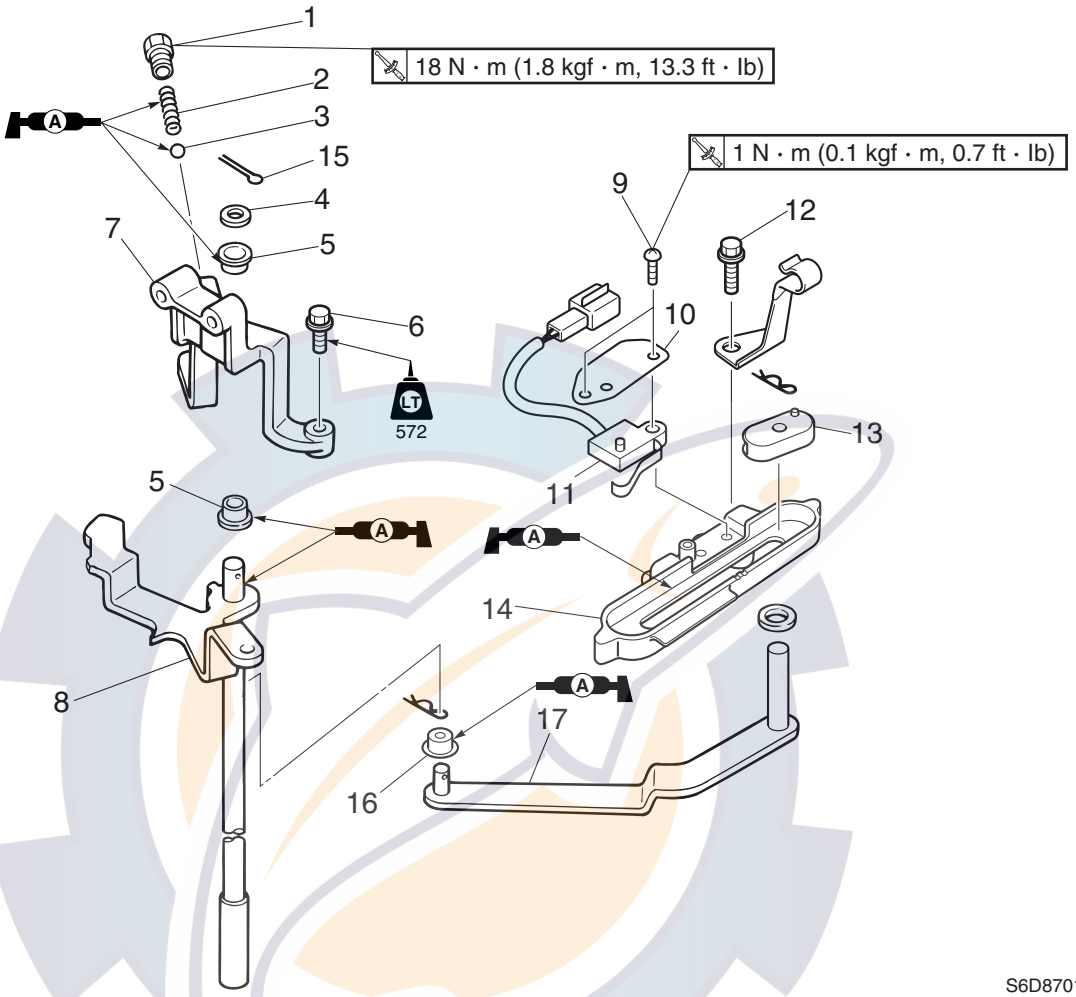
Shift rod



No.	Part name	Q'ty	Remarks
1	Bolt	1	
2	Spring	1	
3	Ball	1	
4	Washer	1	
5	Bushing	2	
6	Bolt	2	M6 × 25 mm
7	Bracket	1	
8	Shift rod	1	
9	Screw	2	ø4 × 16 mm
10	Plate	1	
11	Shift position switch	1	
12	Bolt	2	M6 × 50 mm
13	Bushing	1	
14	Bracket	1	
15	Cotter pin	1	**Not reusable**
16	Bushing	1	
17	Lever	1	

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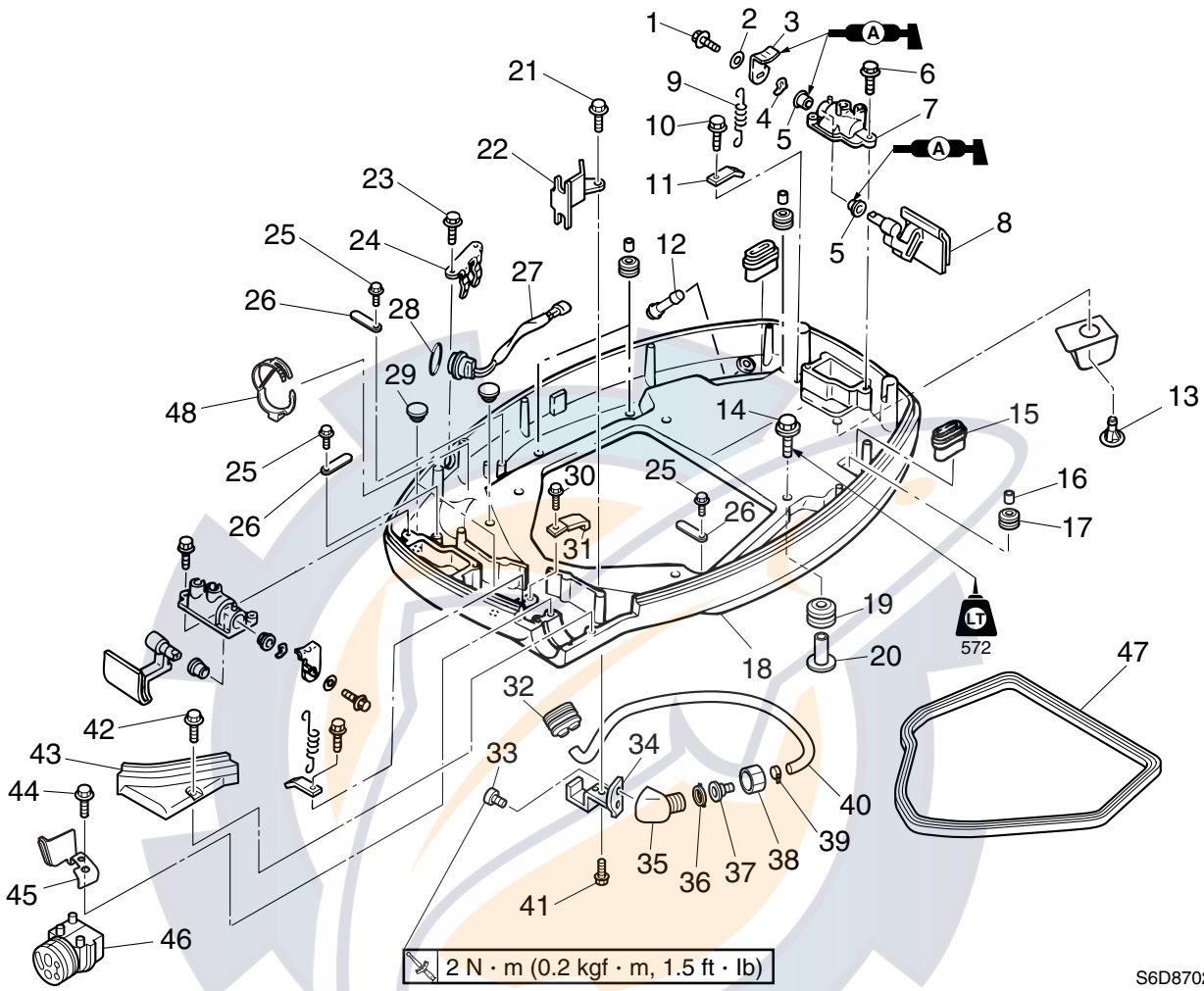
Bottom cowling



No.	Part name	Q'ty	Remarks
1	Bolt	2	M6 × 16 mm
2	Washer	2	
3	Lever	2	
4	Washer	2	
5	Bushing	4	
6	Bolt	4	M6 × 30 mm
7	Base	2	
8	Lever	2	
9	Spring	2	
10	Bolt	2	M6 × 20 mm
11	Hook	2	
12	Cooling water outlet	1	
13	Canister outlet	1	
14	Bolt	4	M8 × 35 mm
15	Grommet	4	
16	Collar	5	
17	Grommet	5	

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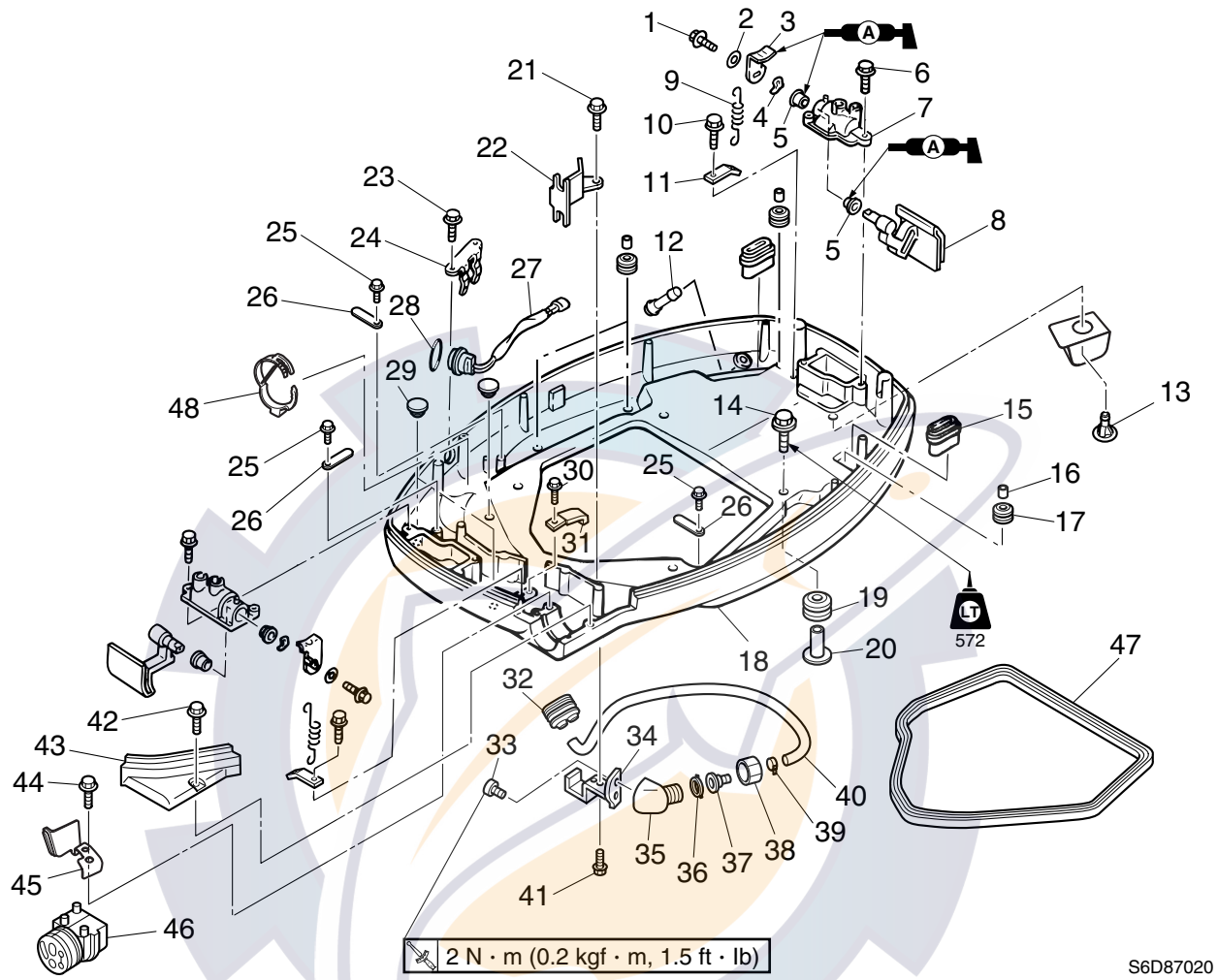

No.	Part name	Q'ty	Remarks
18	Bottom cowling	1	
19	Grommet	4	
20	Collar	4	
21	Bolt	1	M6 × 20 mm
22	Holder	1	
23	Bolt	2	M6 × 20 mm
24	Bracket	1	
25	Bolt	3	M6 × 25 mm
26	Plate	3	
27	Power trim and tilt switch	1	
28	Grommet	1	
29	Grommet	3	
30	Bolt	1	M6 × 20 mm
31	Plate	1	
32	Grommet	1	
33	Screw	2	ø6 × 19 mm
34	Bracket	1	

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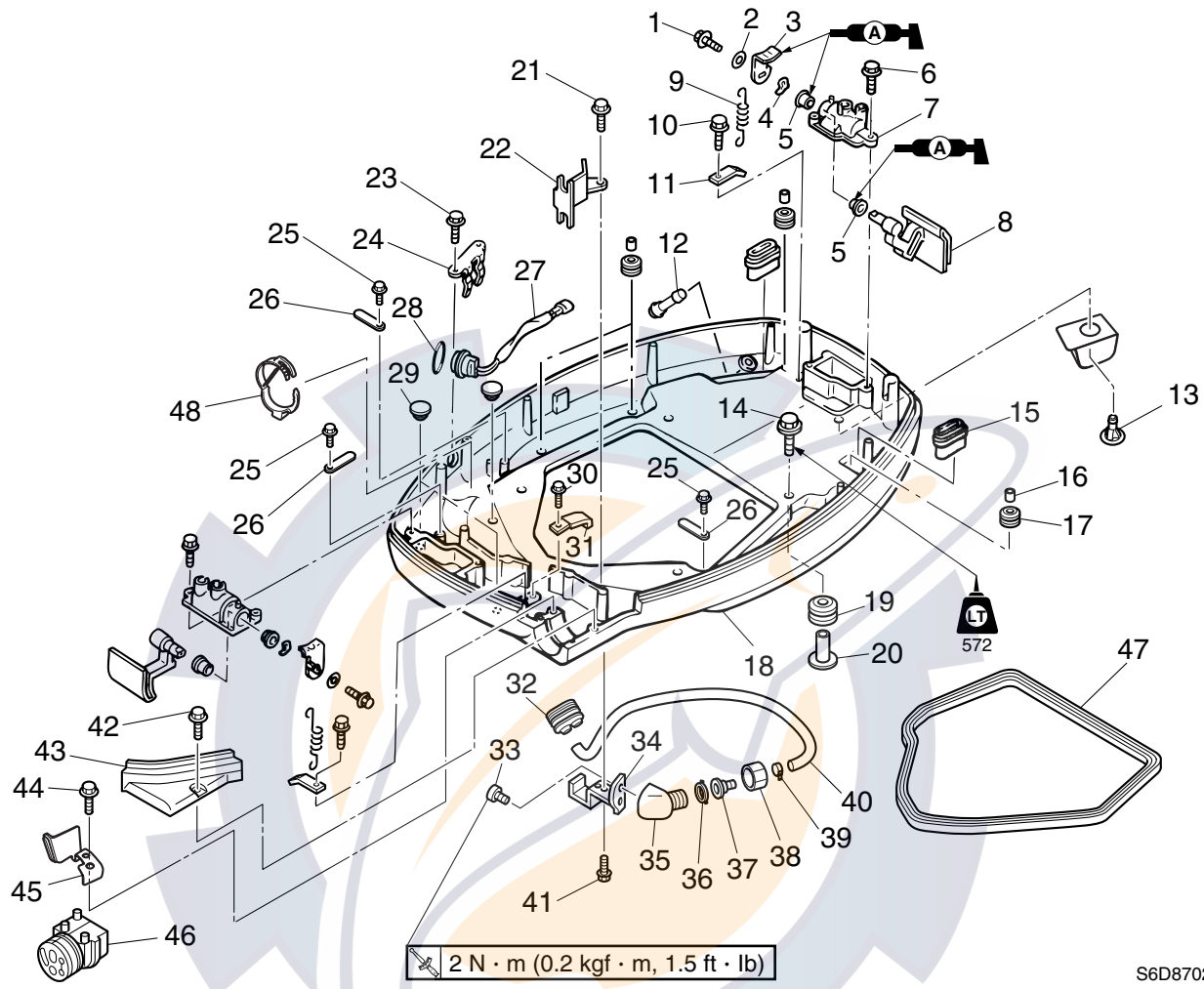

No.	Part name	Q'ty	Remarks
35	Adapter	1	
36	Gasket	1	
37	Joint	1	
38	Joint	1	
39	Plastic tie	1	**Not reusable**
40	Hose	1	
41	Bolt	1	M6 × 20 mm
42	Bolt	2	M6 × 25 mm
43	Retaining plate	1	
44	Bolt	1	M6 × 20 mm
45	Plate	1	
46	Grommet	1	
47	Rubber seal	1	
48	Clamp	1	

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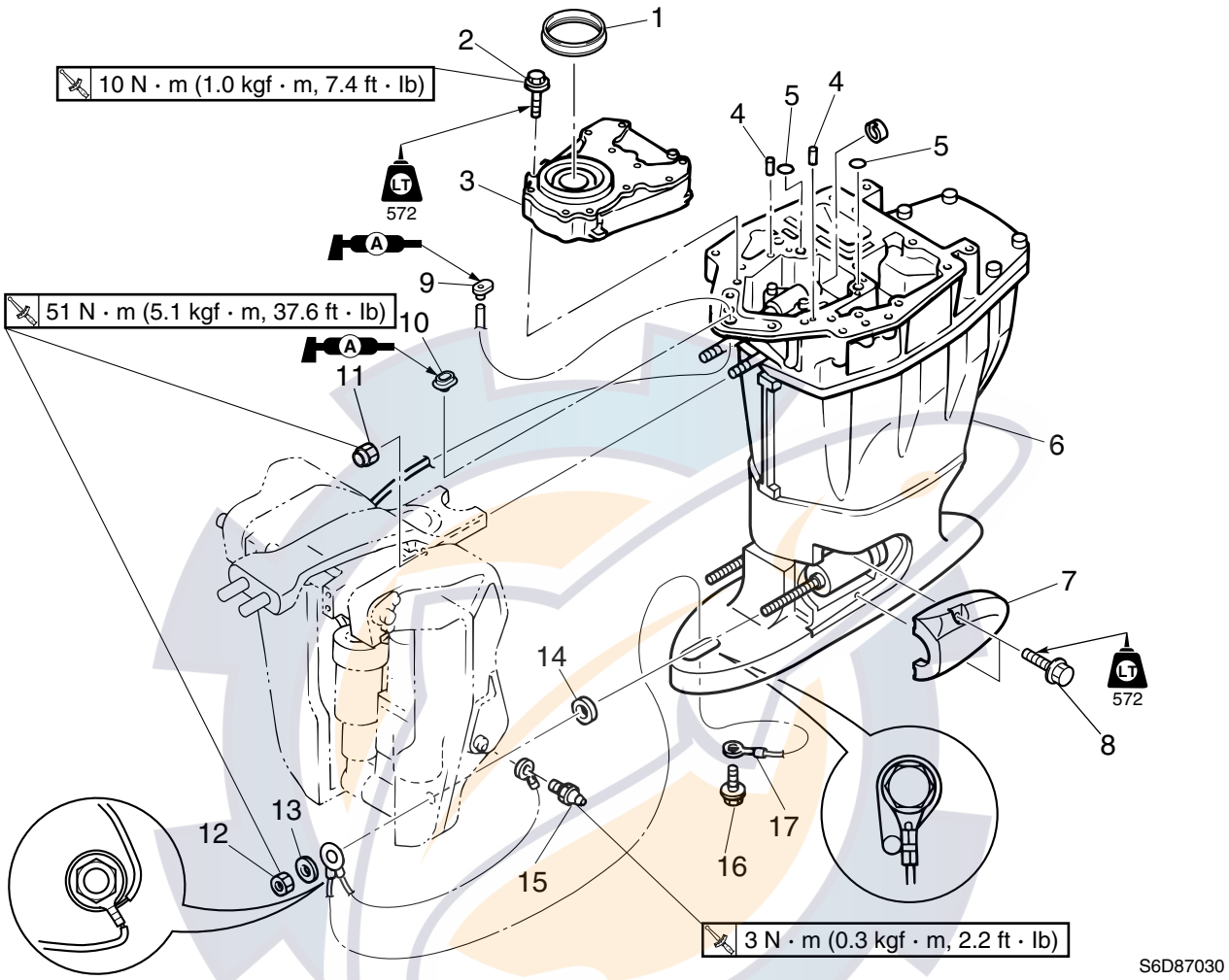
Upper case



No.	Part name	Q'ty	Remarks
1	Oil seal	1	**Not reusable**
2	Bolt	6	M6 × 45 mm
3	Oil pump assembly	1	
4	Dowel	2	
5	O-ring	2	**Not reusable**
6	Upper case assembly	1	
7	Cover	2	
8	Bolt	4	M10 × 40 mm
9	Grommet	1	
10	Grommet	1	
11	Nut	2	
12	Nut	2	
13	Washer	2	
14	Washer	2	
15	Grease nipple	1	
16	Bolt	1	M8 × 16 mm
17	Ground lead	1	

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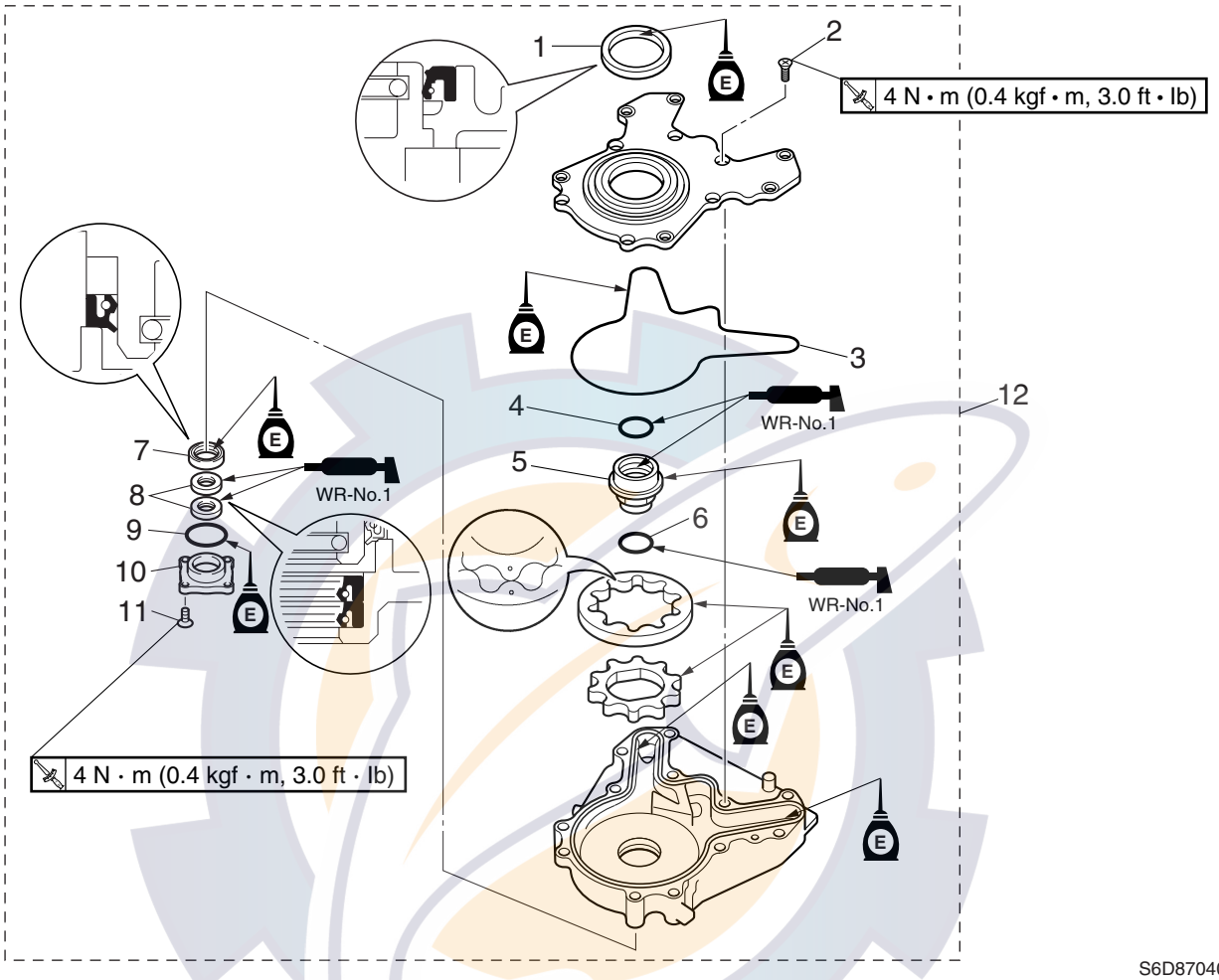

S6D87040

No.	Part name	Q'ty	Remarks
1	Oil seal	1	Not reusable
2	Screw	6	ø6 × 10 mm
3	Gasket	1	Not reusable
4	O-ring	1	Not reusable
5	Shaft	1	
6	O-ring	1	Not reusable
7	Oil seal	1	Not reusable
8	Oil seal	2	Not reusable
9	O-ring	1	Not reusable
10	Oil seal housing	1	
11	Screw	4	ø6 × 10 mm
12	Oil pump assembly	1	

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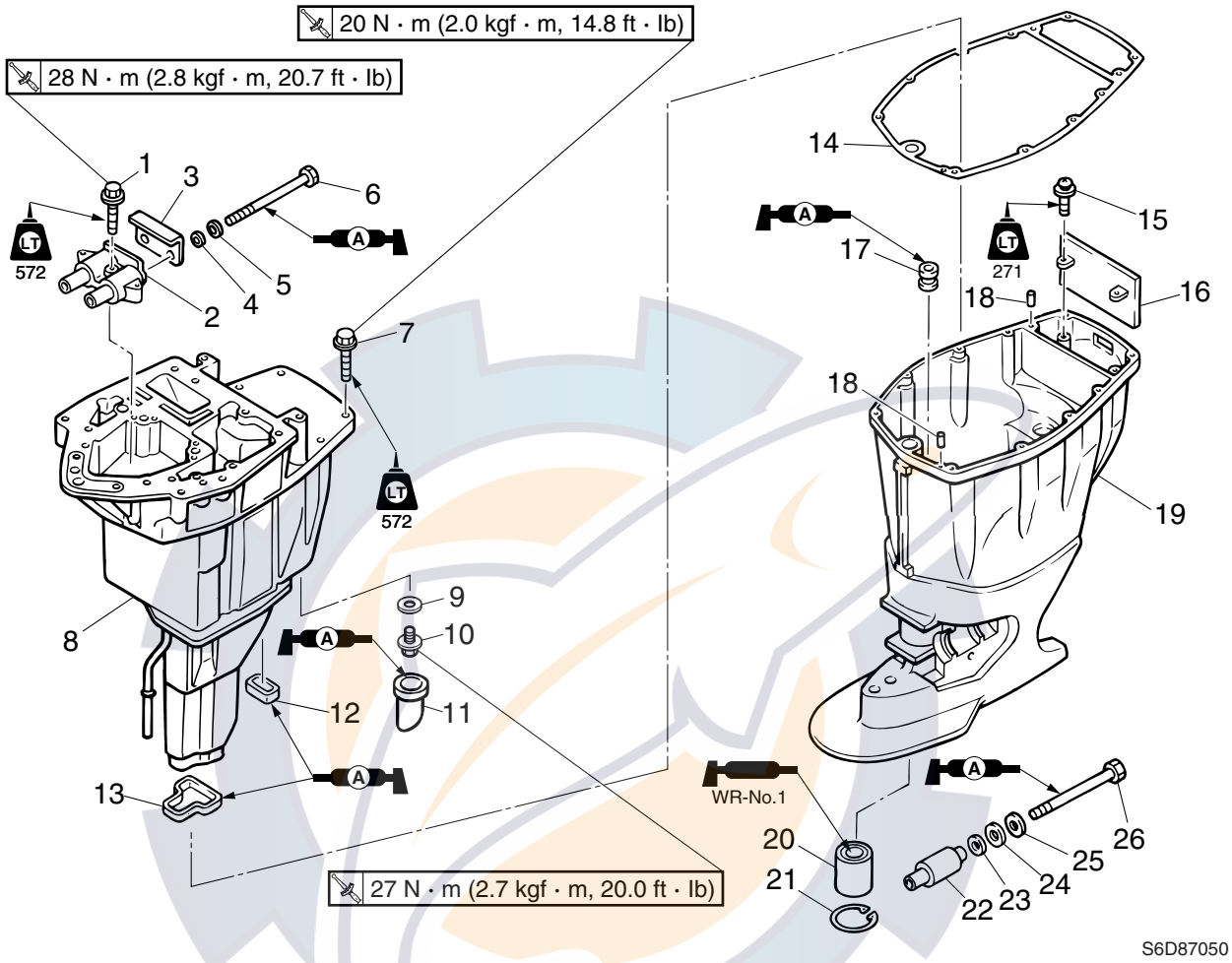

No.	Part name	Q'ty	Remarks
1	Bolt	3	M8 × 45 mm
2	Upper mount	1	
3	Plate	1	
4	Washer	2	
5	Washer	2	
6	Bolt	2	M12 × 194 mm
7	Bolt	4	M8 × 40 mm
8	Muffler assembly	1	
9	Gasket	1	
10	Drain bolt	1	M14 × 12 mm
11	Damper	1	
12	Rubber seal	1	
13	Gasket	1	**Not reusable**
14	Gasket	1	**Not reusable**
15	Screw	2	ø6 × 15 mm
16	Baffle plate	1	
17	Grommet	1	

7

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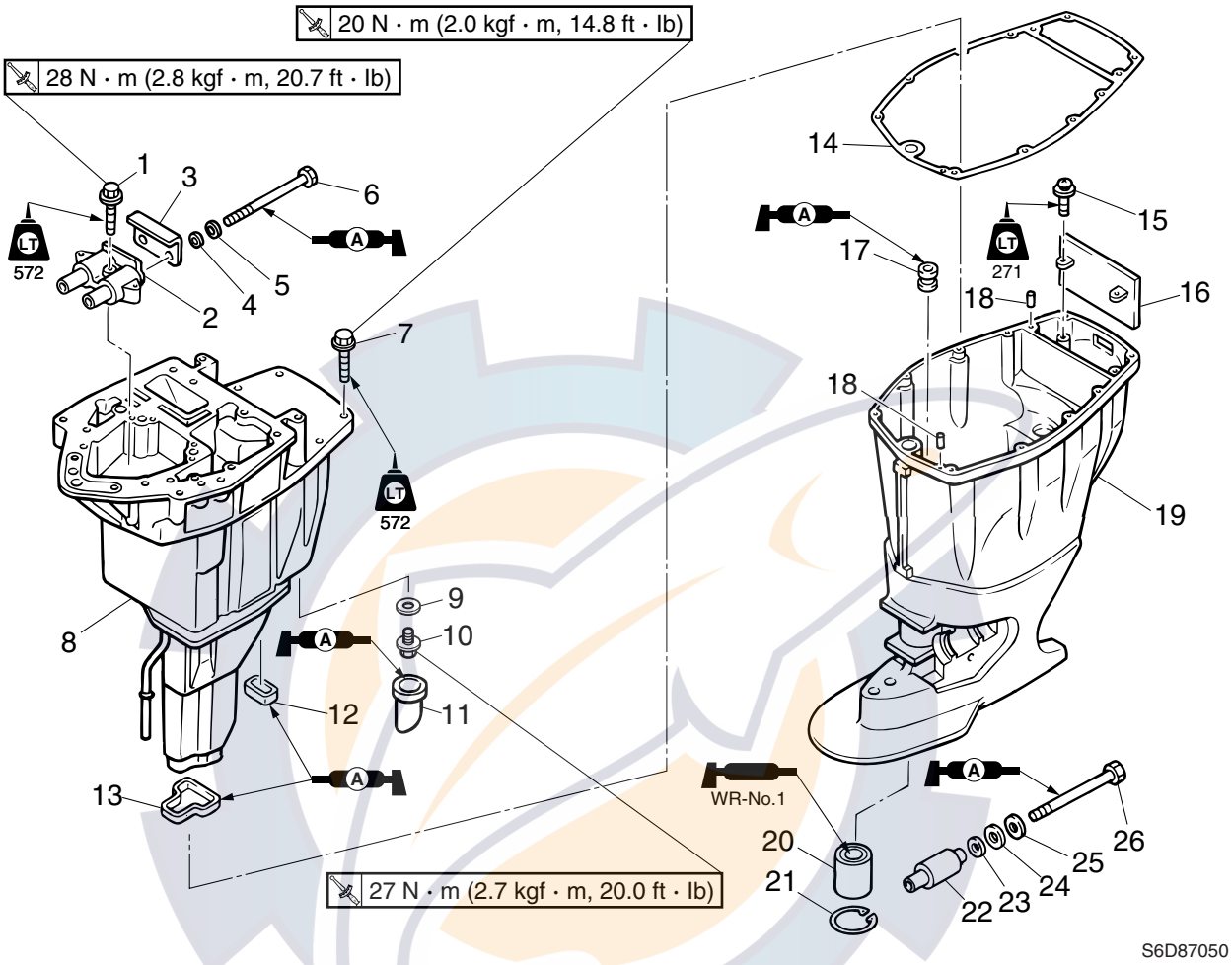

No.	Part name	Q'ty	Remarks
18	Dowel	2	
19	Upper case	1	
20	Drive shaft bushing	1	
21	Circlip	1	
22	Lower mount	2	
23	Washer	2	
24	Washer	2	
25	Washer	2	
26	Bolt	2	M12 × 200 mm

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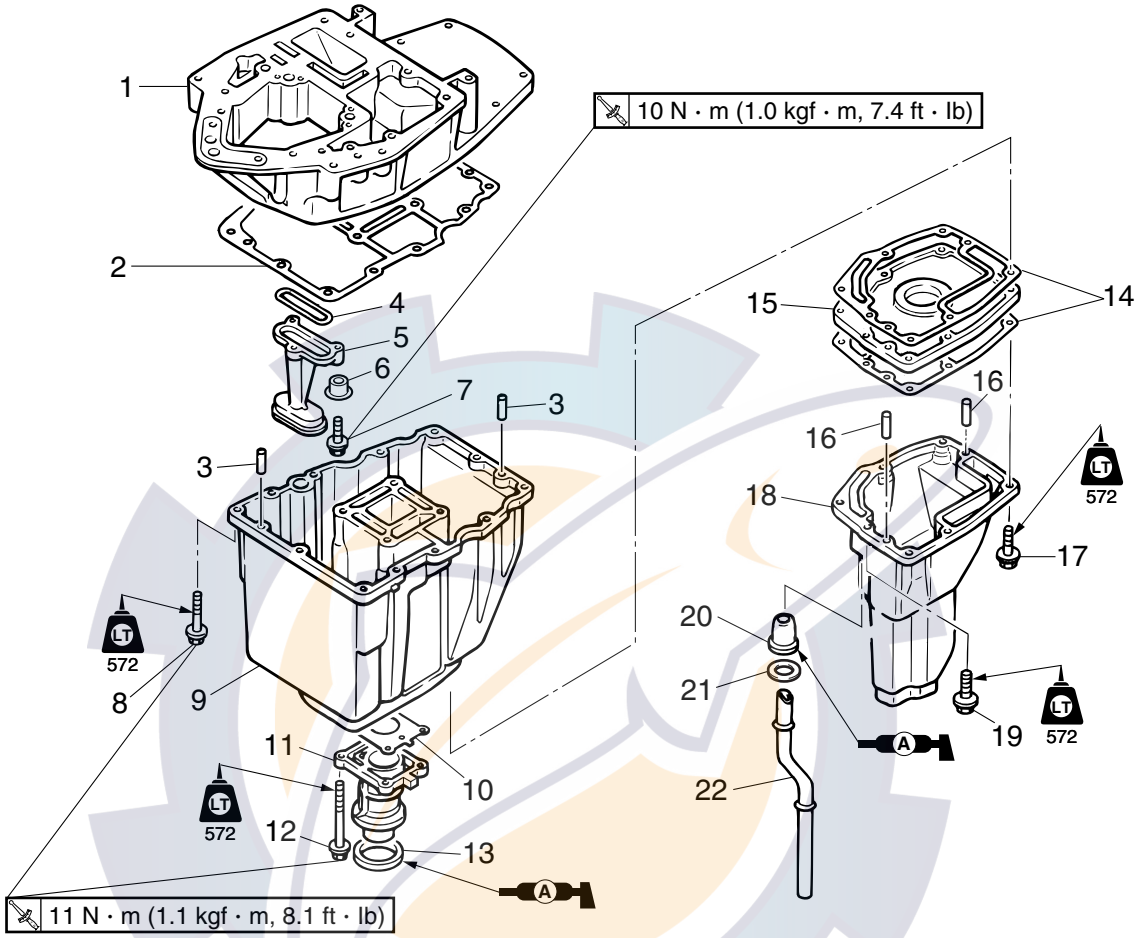

S6D87060

No.	Part name	Q'ty	Remarks
1	Exhaust guide	1	
2	Gasket	1	Not reusable
3	Dowel	2	
4	Gasket	1	Not reusable
5	Oil strainer	1	
6	Collar	3	
7	Bolt	3	M6 × 25 mm
8	Bolt	12	M6 × 25 mm
9	Oil pan	1	
10	Gasket	1	Not reusable
11	Exhaust manifold	1	
12	Bolt	4	M6 × 70 mm
13	Gasket	1	Not reusable
14	Gasket	2	Not reusable
15	Plate	1	
16	Dowel	2	
17	Bolt	6	M6 × 30 mm

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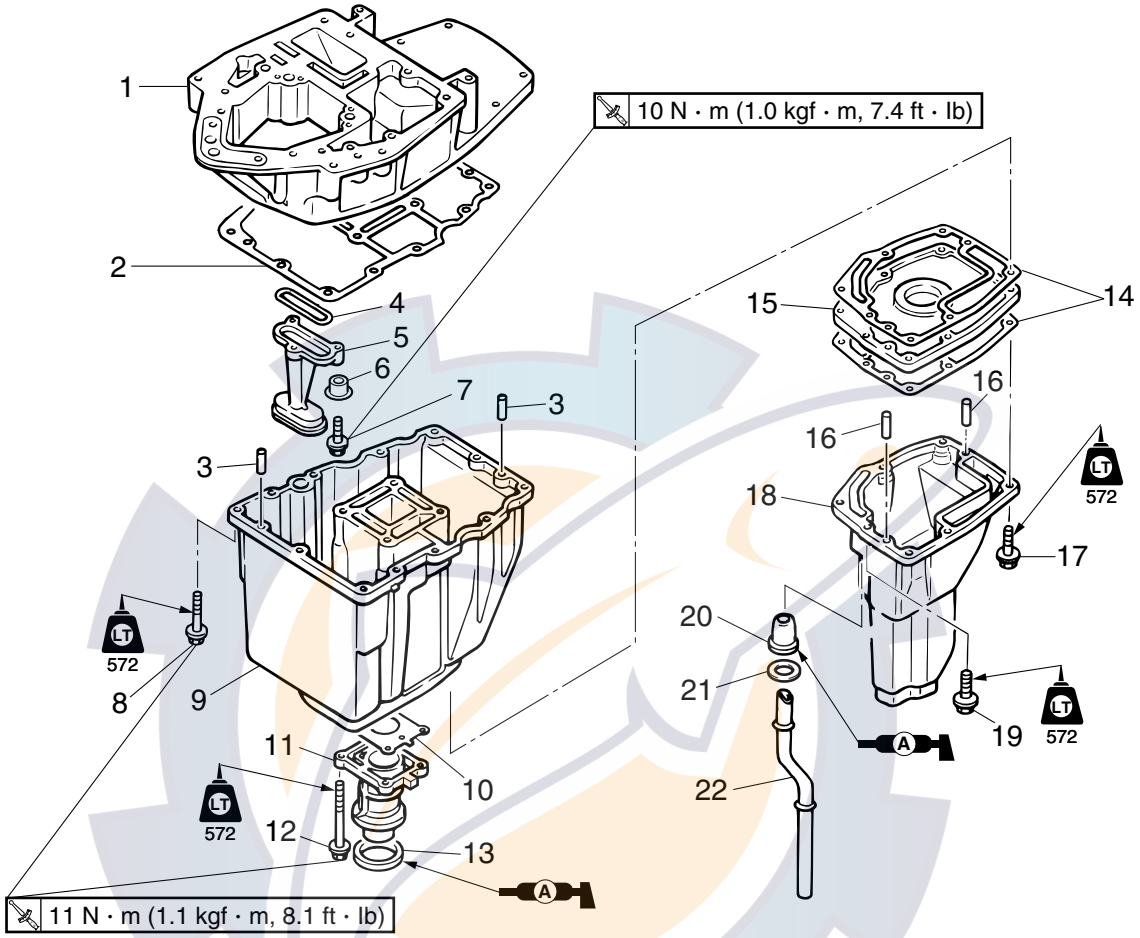

No.	Part name	Q'ty	Remarks
18	Muffler	1	
19	Bolt	1	M6 × 50 mm
20	Grommet	1	
21	Spacer	1	
22	Pipe	1	

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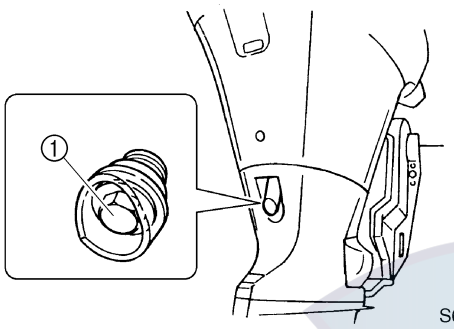
Removing the upper case

1. Place a drain pan under the drain hole, and then remove the drain bolt ① and let the oil drain completely.



S63P7140

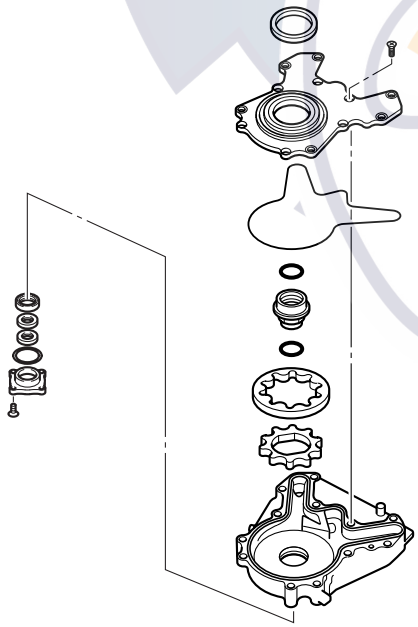
2. Remove the oil pump assembly and mount covers.

3. Disconnect the ground lead and speedometer hose.

4. Remove the upper and lower mounting nuts, and then remove the upper case.

Disassembling the oil pump

1. Remove the screws and disassemble the oil pump.



S6D87070

Checking the oil pump

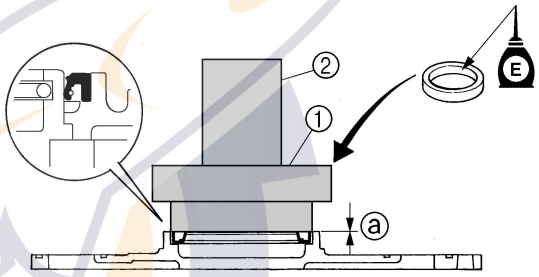
1. Check the gear teeth for cracks or wear and the oil pump case for scratches. Replace the oil pump assembly if necessary.

2. Check the shaft for cracks or wear. Replace if necessary.

3. Check the oil passage for dirt or residue. Clean if necessary.

Assembling the oil pump

1. Install a new oil seal into the oil pump cover to the specified depth.

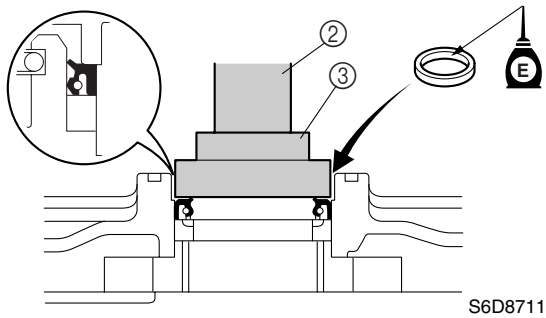


S6D87100

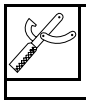
	Bearing installer ①: YB-41446 Driver handle (large) ②: YB-06071

	Depth ⓐ: 0.5 ± 0.3 mm (0.02 ± 0.01 in)

2. Install a new oil seal into the oil pump housing.



S6D87110

	Bearing cup installer ③: YB-06167 Driver handle (large) ②: YB-06071

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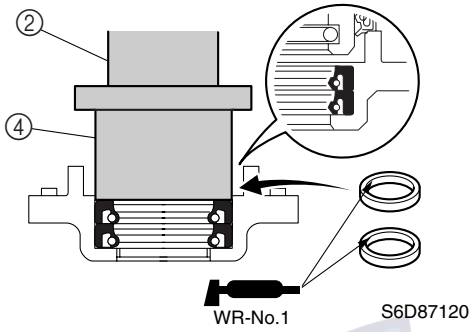
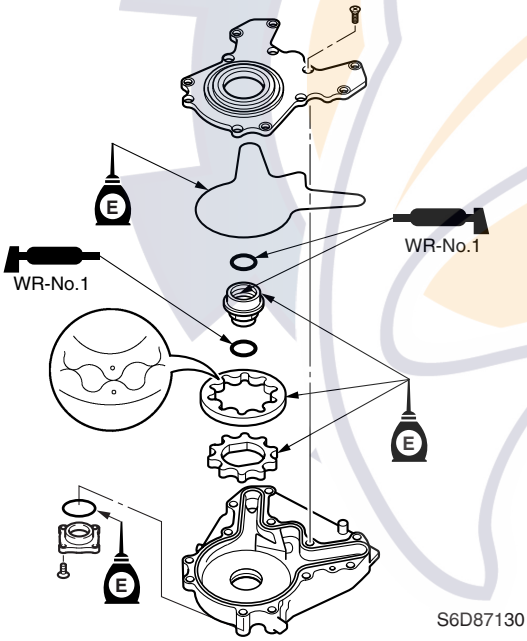
3. Install new oil seals into the oil seal housing.



Roller bearing installer/remover ④: YB-06432
Driver handle (large) ②: YB-06071

4. Install new o-rings and the gasket, and then tighten the screws to the specified torque.

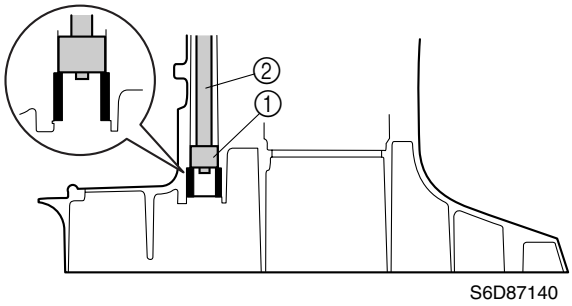


Oil pump cover screw:
4 N·m (0.4 kgf·m, 3.0 ft·lb)

Disassembling the upper case

1. Remove the muffler assembly from the upper case.

2. Remove the circlip, then the drive shaft bushing.



Oil seal installer ①: YB-06023
Driver handle (small) ②: YB-06229

Checking the drive shaft bushing

1. Check the drive shaft bushing for wear or cracks. Replace if necessary.

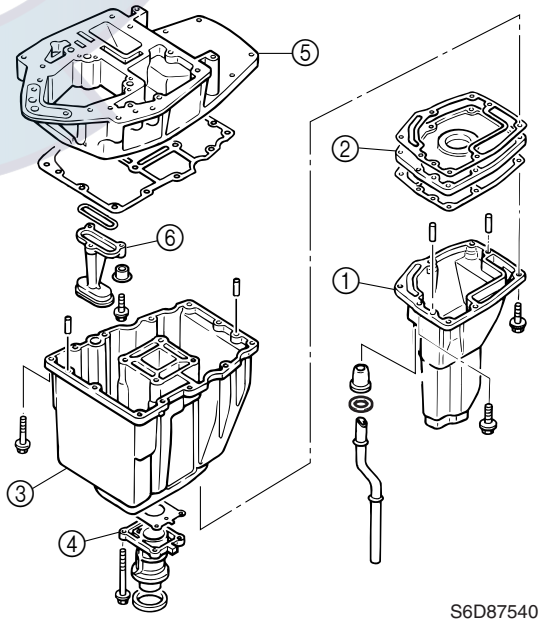
Disassembling the oil pan

1. Remove the muffler ① and plate ② from the oil pan ③.

2. Remove the exhaust manifold ④ from the oil pan ③.

3. Remove the oil pan ③ from the exhaust guide ⑤.

4. Remove the oil strainer ⑥.



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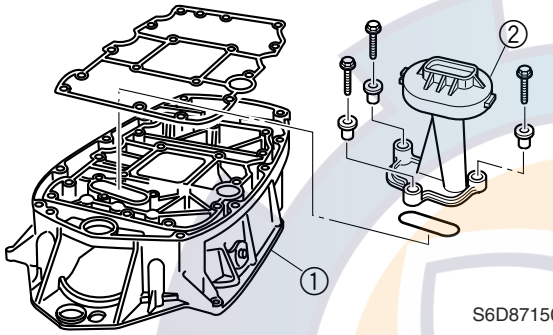
Checking the oil strainer

1. Check the oil strainer for dirt or residue. Clean if necessary.

Assembling the oil pan

1. Install a new gasket onto the exhaust guide ①.

2. Install a new gasket and the oil strainer ② onto the exhaust guide, and then tighten the bolts to the specified torque.



S6D87150

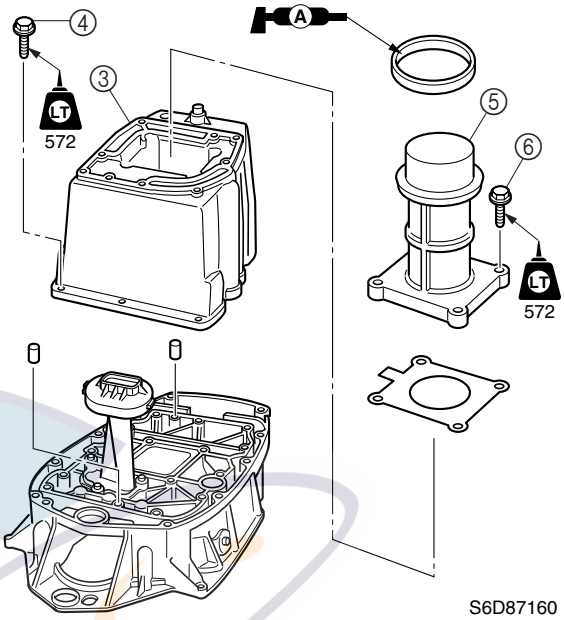
Oil strainer bolt:
10 N·m (1.0 kgf·m, 7.4 ft·lb)

3. Install the dowels and oil pan ③ onto the exhaust guide, and then tighten the oil pan bolts ④ finger tight.

4. Install a new gasket and the exhaust manifold ⑤ onto the oil pan, and then tighten the exhaust manifold bolts ⑥ to the specified torque.

5. Tighten the oil pan bolts ④ to the specified torque.

6. Tighten the exhaust manifold bolts ⑥ again to the specified torque.

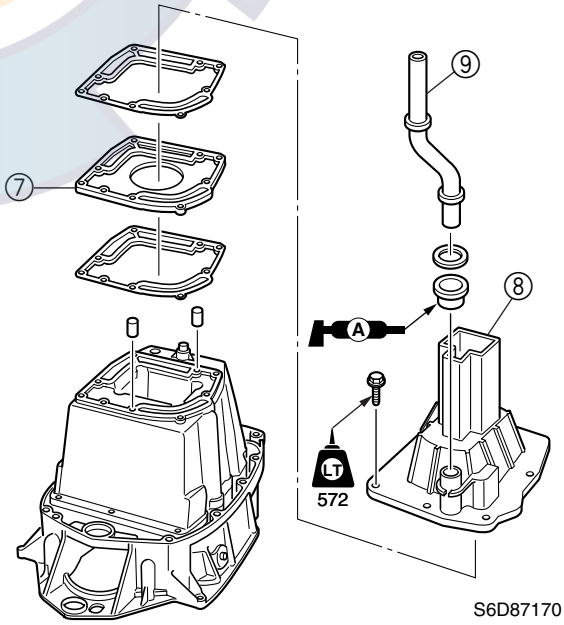


S6D87160

Oil pan bolt ④:
11 N·m (1.1 kgf·m, 8.1 ft·lb)
Exhaust manifold bolt ⑥:
11 N·m (1.1 kgf·m, 8.1 ft·lb)

7. Install new gaskets, the plate ⑦, and the muffler ⑧ onto the oil pan.

8. Install the water pipe ⑨.



S6D87170

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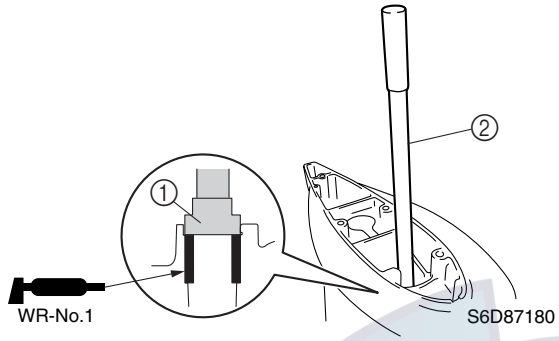
Assembling the upper case

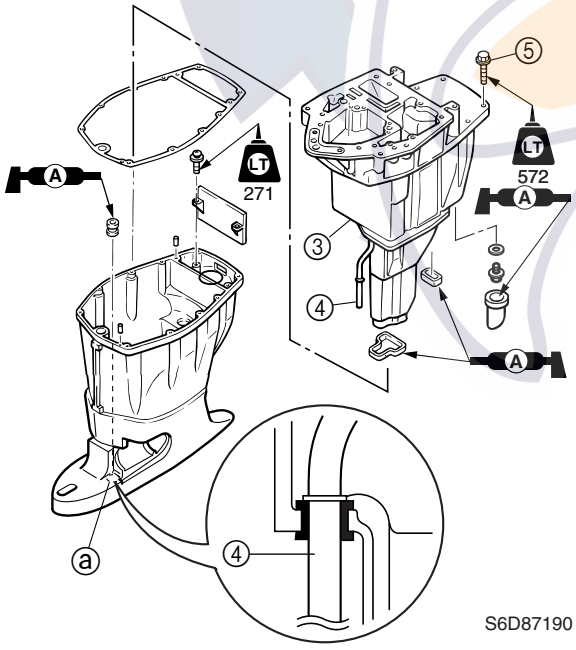
1. Install the drive shaft bushing into the upper case, and then install the circlip.



Drive shaft needle bearing installer and remover ①:
YB-06196
Driver handle (large) ②:
YB-06071

2. Install the muffler assembly ③ by inserting the tip of the water pipe ④ into the joint hole ⓐ of the upper case.

3. Install the muffler assembly bolts ⑤, and then tighten them to the specified torque.

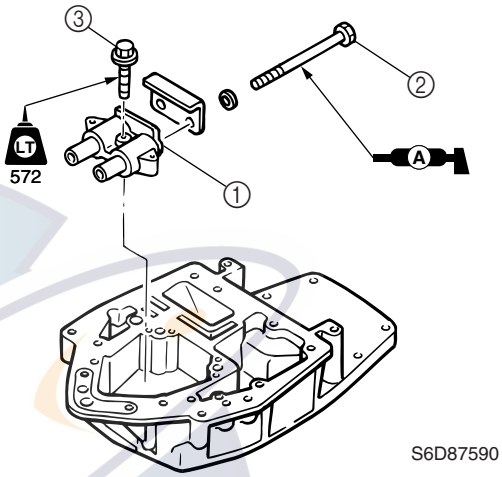


Muffler assembly bolt ⑤:
20 N·m (2.0 kgf·m, 14.8 ft·lb)

Installing the upper case

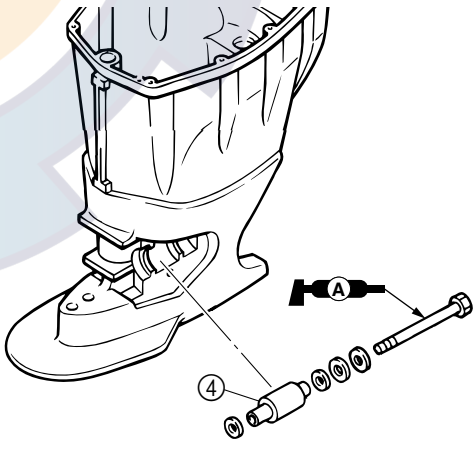
1. Install the upper mount ① and bolts ② into the upper case.

2. Install the bolts ③, and then tighten them to the specified torque.



Upper mount bolt ③:
28 N·m (2.8 kgf·m, 20.7 ft·lb)

3. Install the lower mounts ④ onto the upper case.



4. Install the upper and lower mounting bolts into the bracket ⑤ simultaneously.

5. Install the upper mounting nut ⑥ and lower mounting nut ⑦, and then tighten them to the specified torques.

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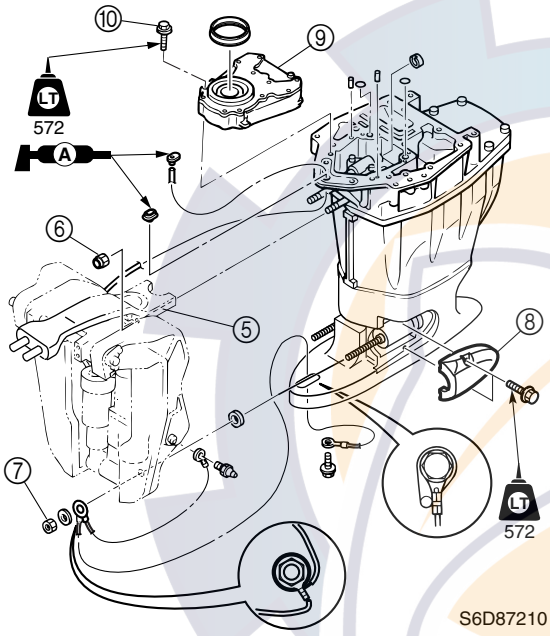
NOTE:
Before tightening the lower mounting nut, be sure to connect the ground lead to the lower mounting bolt.

6. Install the mount covers ⑧.

7. Install the oil pump assembly ⑨ and the bolts ⑩, and then tighten them to the specified torque.



NOTE:
When installing the oil pump assembly onto the upper case, pour a small amount of engine oil into the oil inlet or oil outlet of the oil pump assembly.

Upper mounting nut ⑥:
51 N·m (5.1 kgf·m, 37.6 ft·lb)
Lower mounting nut ⑦:
51 N·m (5.1 kgf·m, 37.6 ft·lb)
Oil pump bolt ⑩:
10 N·m (1.0 kgf·m, 7.4 ft·lb)
Grease nipple:
3 N·m (0.3 kgf·m, 2.2 ft·lb)

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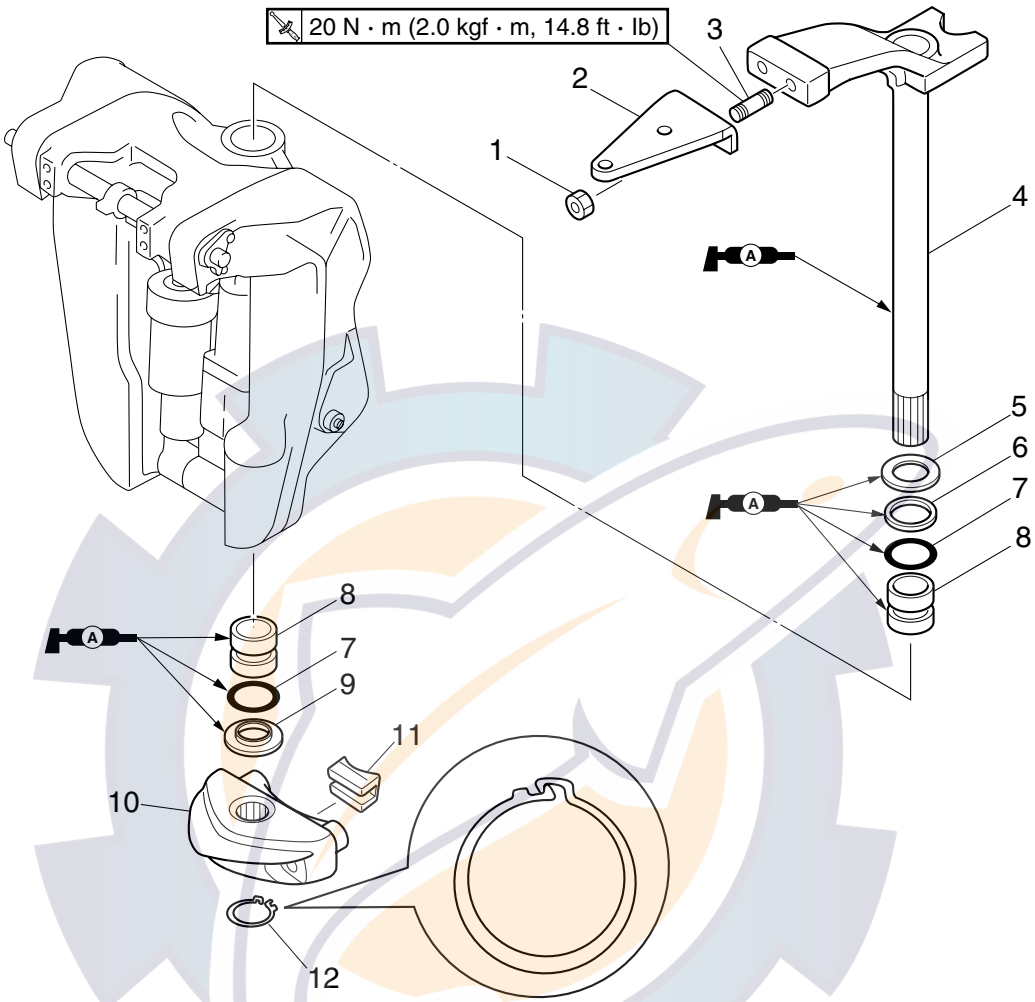
Steering arm



No.	Part name	Q'ty	Remarks
1	Nut	2	
2	Steering hook	1	
3	Stud bolt	2	M10 × 40 mm
4	Steering arm	1	
5	Washer	1	
6	Bushing	1	
7	O-ring	2	**Not reusable**
8	Bushing	2	
9	Washer	1	
10	Steering yoke	1	
11	Damper	1	
12	Circlip	1	

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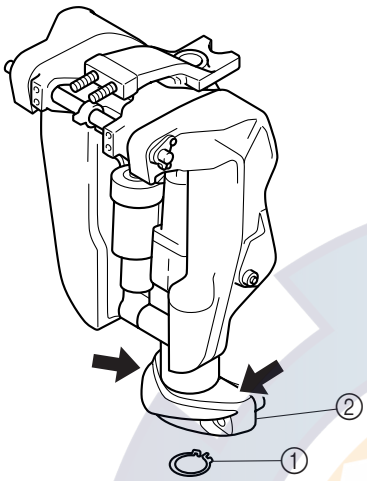
Removing the steering arm

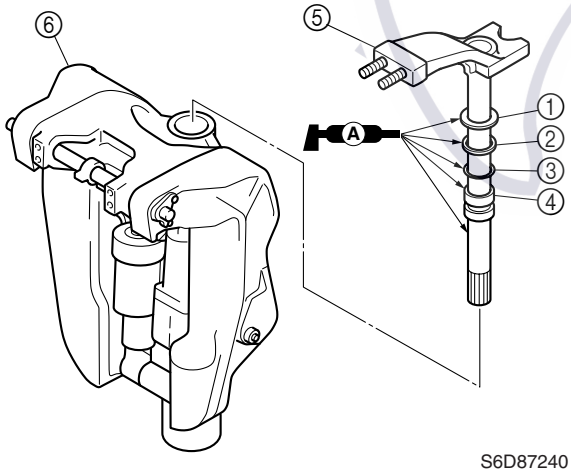
1. Remove the circlip ①.
2. Remove the steering yoke ② by striking it with a plastic hammer.



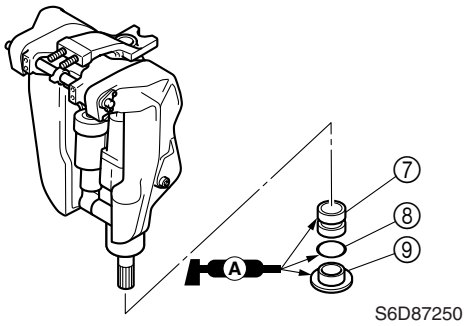
3. Remove the steering arm from the swivel bracket by pulling the arm off the bracket.

Installing the steering arm

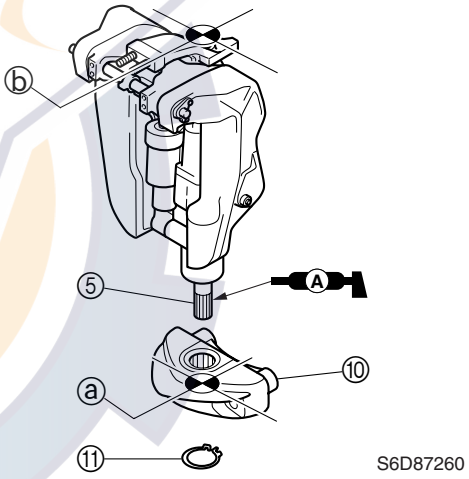
1. Install the washer ①, bushing ②, O-ring ③, and bushing ④ onto the steering arm ⑤.
2. Place the swivel bracket ⑥ in an upright position, and then install the steering arm onto the swivel bracket.



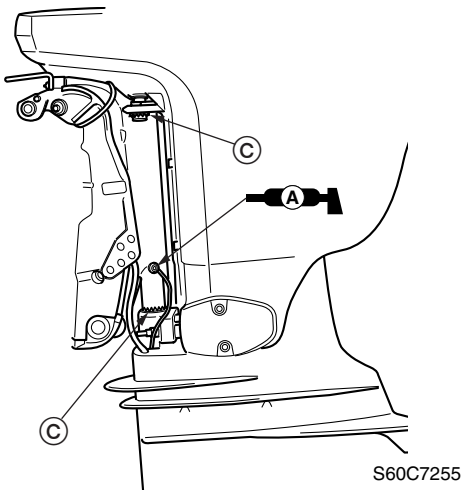
3. Install the bushing ⑦, O-ring ⑧, and washer ⑨ onto the swivel bracket.



4. Install the steering yoke ⑩ to the steering arm ⑤ by aligning the center ⓐ of the yoke with the center ⓑ of the steering arm.
5. Install the circlip ⑪.



6. Inject grease into the grease nipple until grease comes out from both the upper and lower bushings ⓒ.



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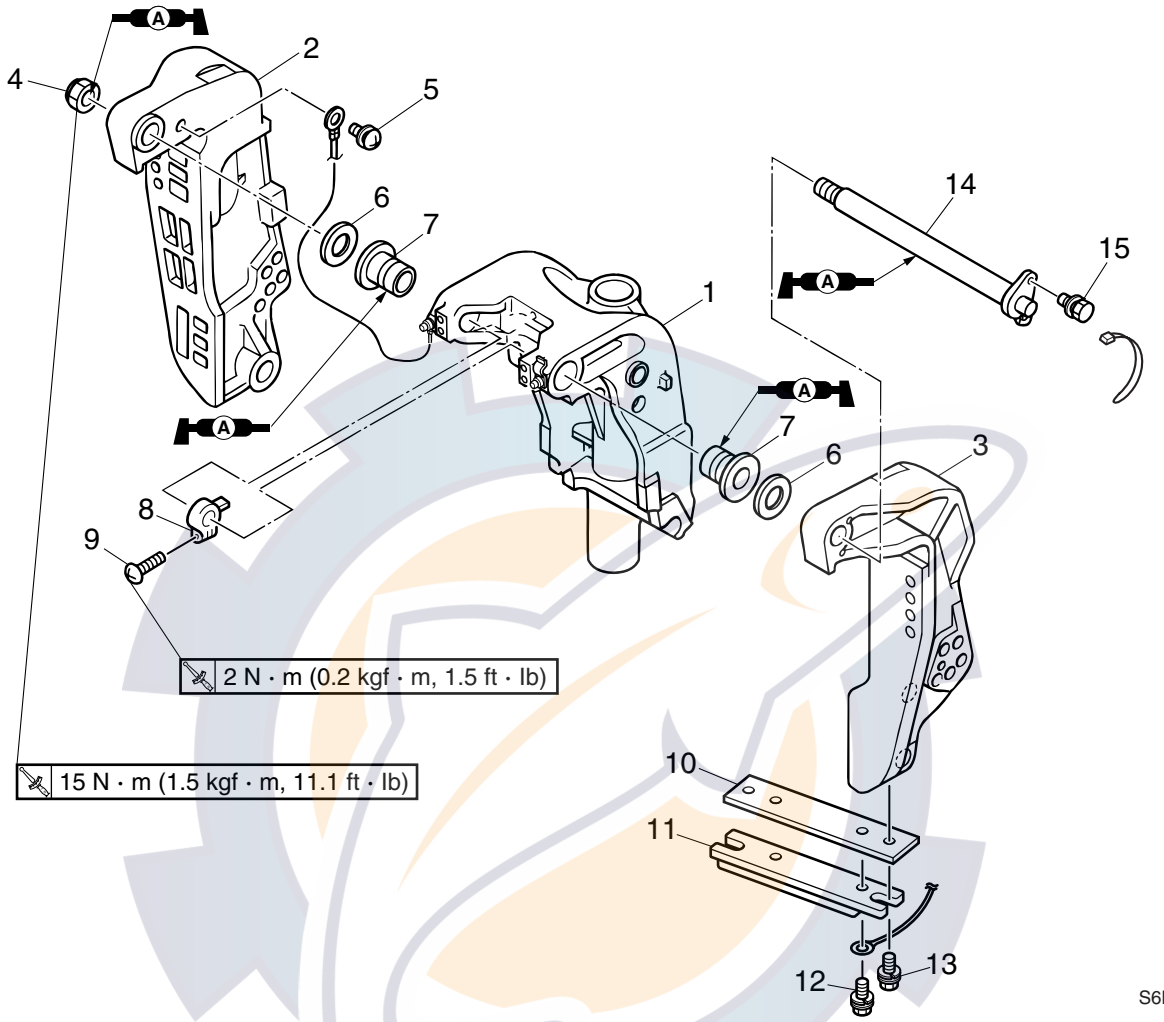
Clamp brackets and swivel bracket



No.	Part name	Q'ty	Remarks
1	Swivel bracket	1	
2	Clamp bracket	1	
3	Clamp bracket	1	
4	Self-locking nut	1	
5	Screw	1	ø6 × 12 mm
6	Washer	2	
7	Bushing	2	
8	Trim sensor cam	1	
9	Screw	1	ø6 × 25 mm
10	Plate	1	
11	Anode	1	
12	Bolt	1	M6 × 14 mm
13	Bolt	2	M6 × 16 mm
14	Through tube	1	
15	Bolt	1	M8 × 20 mm

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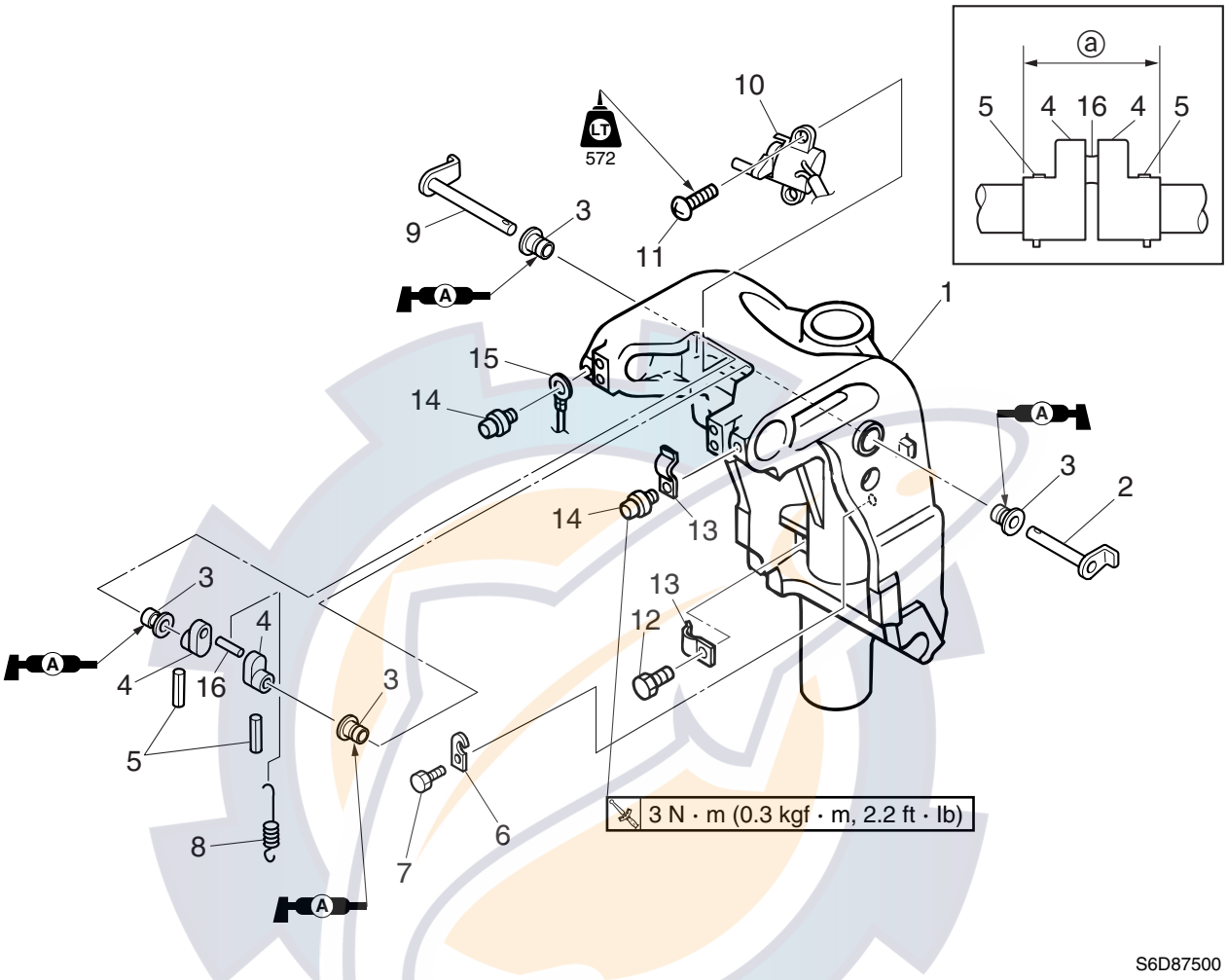

S6D87500

No.	Part name	Q'ty	Remarks
1	Swivel bracket	1	
2	Tilt stop lever	1	
3	Bushing	4	
4	Distance collar	2	ⓐ: 30.3–30.6 mm (1.19–1.20 in)
5	Pin	2	
6	Hook	1	
7	Bolt	1	M6 × 10 mm
8	Spring	1	
9	Tilt stop lever	1	
10	Trim sensor	1	
11	Screw	2	ø6 × 15 mm
12	Bolt	1	M6 × 10 mm
13	Clamp	2	
14	Grease nipple	2	
15	Ground lead	1	
16	Pin	1	

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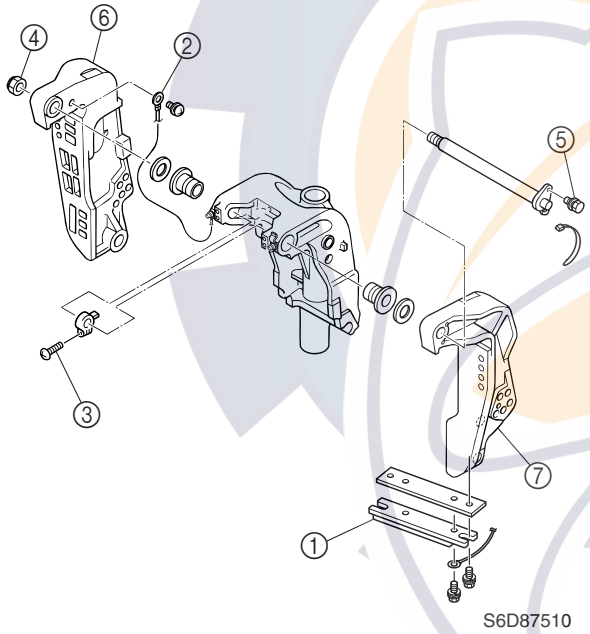
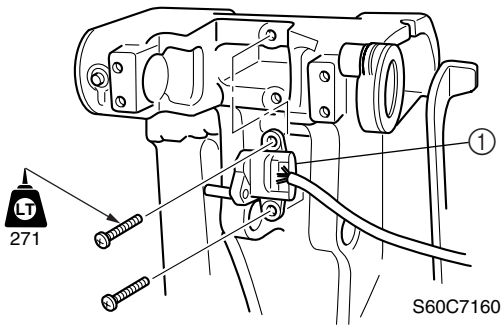
Removing the clamp brackets

1. Remove the power trim and tilt unit. For removal procedure, see “Removing the power trim and tilt unit.”
2. Remove the anode ①.
3. Disconnect the ground lead ②.
4. Remove the trim sensor cam screw ③.
5. Loosen the self-locking nut ④ and the bolt ⑤, and then remove clamp brackets ⑥ and ⑦.
6. Remove the trim sensor.
7. Remove the tilt stop lever.



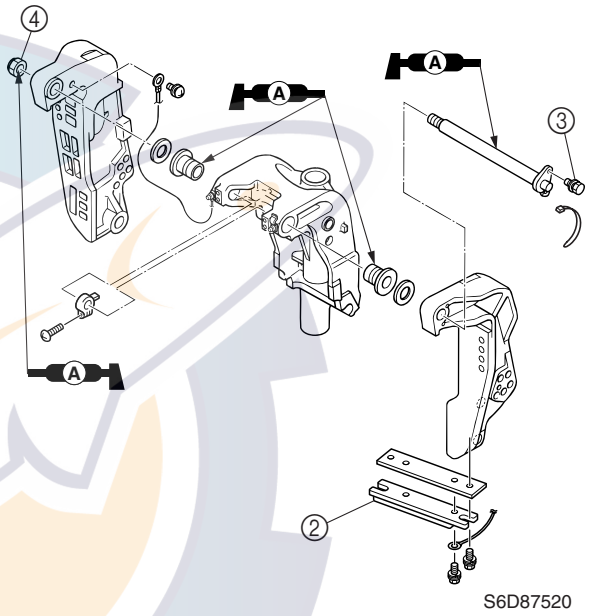
Installing the clamp brackets

1. Install the trim sensor ① onto the swivel bracket.



NOTE:
Adjust the trim sensor after installing the power trim and tilt unit.

2. Assemble the clamp brackets and the swivel bracket by installing the anode ②, bolt ③, and self-locking nut ④, then tightening the nut to the specified torque.



	Self-locking nut ④: 15 N·m (1.5 kgf·m, 11.1 ft·lb)

3. Install the power trim and tilt unit. For installation procedure, see “Installing the power trim and tilt unit.”

Adjusting the trim sensor

1. Fully retract the power trim and tilt unit.
2. Loosen the trim sensor cam screw ①.
3. Adjust the trim sensor cam ② where the specified trim sensor setting resistance is obtained.

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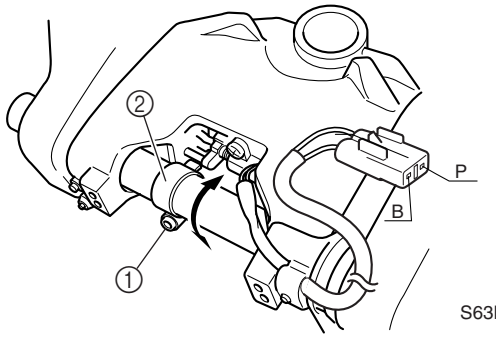
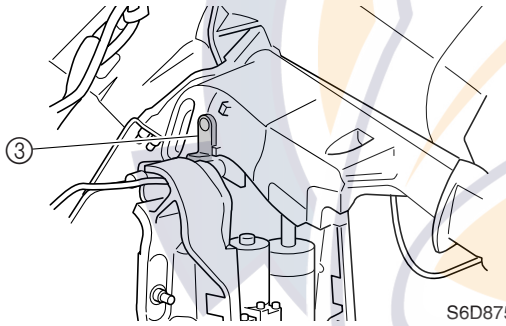


Trim sensor setting resistance:
Pink (P) – Black (B)
10 ± 1 Ω at 20 °C (68 °F)

Trim sensor cam screw ①:
2 N·m (0.2 kgf·m, 1.5 ft·lb)

4. Fully tilt the outboard motor up, and then support it with the tilt stop lever ③.



⚠ WARNING

After tilting up the outboard motor, be sure to support it with the tilt stop lever. Otherwise, the outboard motor could suddenly lower if the power trim and tilt unit should lose fluid pressure.

5. Check the trim sensor resistance. If the resistance is out of specification, adjust the trim sensor cam position and check the trim sensor.

Trim sensor resistance:
Pink (P) – Black (B)
238.8–378.8 Ω at 20 °C (68 °F)

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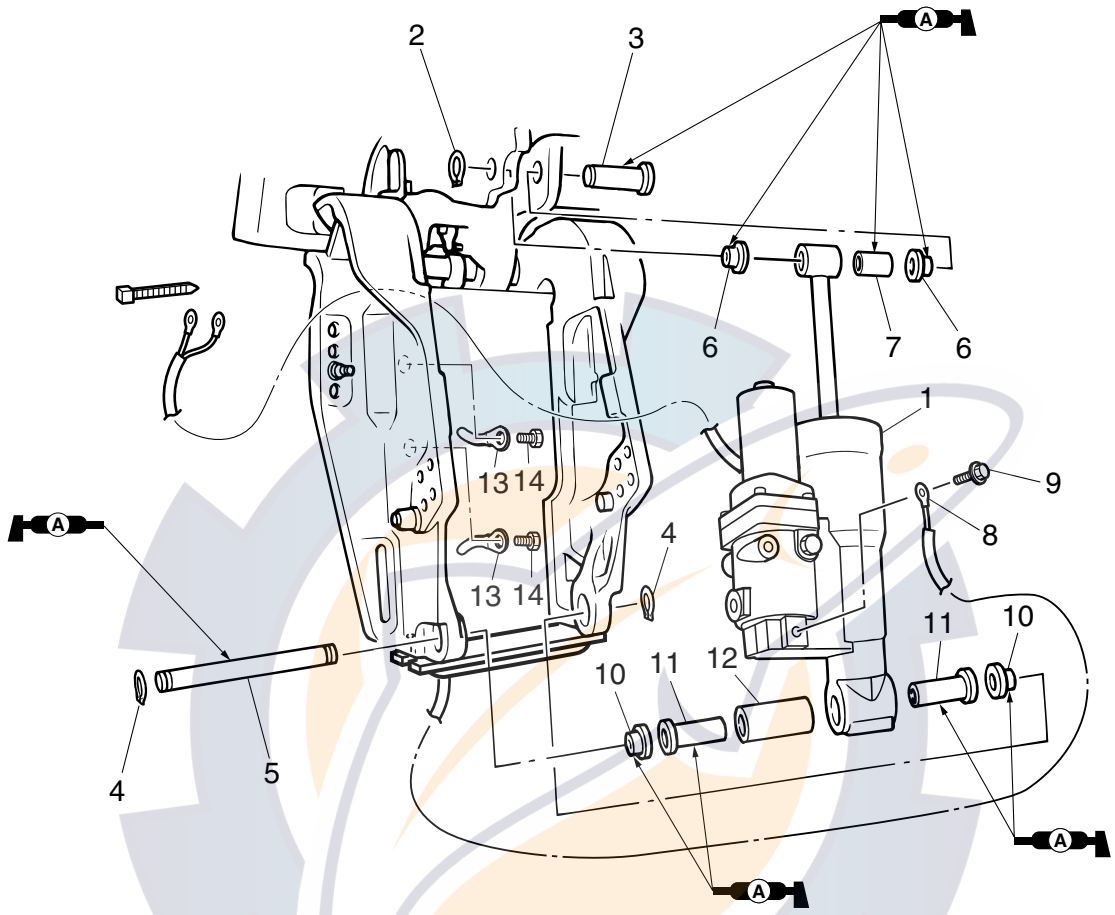
Power trim and tilt unit



S6D87270

No.	Part name	Q'ty	Remarks
1	Power trim and tilt unit	1	
2	Circlip	1	
3	Shaft	1	
4	Circlip	2	
5	Shaft	1	
6	Bushing	2	
7	Bushing	1	
8	Ground lead	1	
9	Bolt	1	M6 × 10 mm
10	Bushing	2	
11	Bushing	2	
12	Collar	1	
13	Holder	2	
14	Bolt	2	M6 × 10 mm

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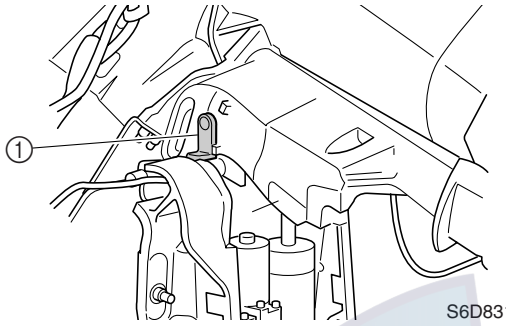
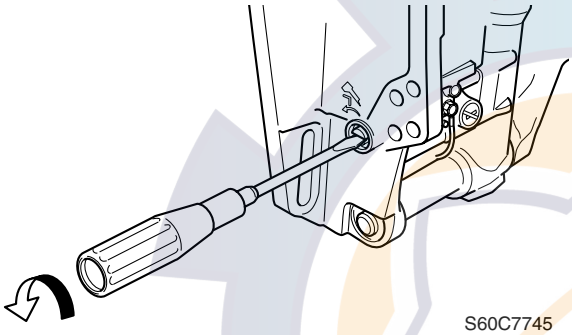
Removing the power trim and tilt unit

1. Fully tilt the outboard motor up, and then support it with the tilt stop lever ①.



S6D83150



S60C7745

⚠ WARNING

After tilting up the outboard motor, be sure to support it with the tilt stop lever. Otherwise, the outboard motor could suddenly lower if the power trim and tilt unit should lose fluid pressure.

NOTE:

- If the power trim and tilt does not operate, loosen the manual valve and tilt the outboard motor up manually.
- If the manual valve is loosened, be sure to tighten it to the specified torque after tilting the outboard motor up.

	Manual valve: 2 N·m (0.2 kgf·m, 1.5 ft·lb)

2. Remove the holders ② and plastic ties, and then pull out the PTT motor leads ③.

3. Remove the bolt ④ and disconnect the ground lead ⑤.

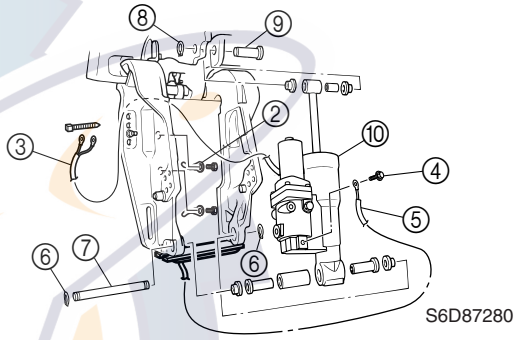
4. Remove the circlips ⑥, then the lower mounting shaft ⑦.

5. Remove the circlip ⑧, then the upper mounting shaft ⑨.

NOTE:

Hold the power trim and tilt unit with one hand, and pull the upper mount shaft out at a downward angle with the other.

6. Remove the power trim and tilt unit ⑩.



S6D87280

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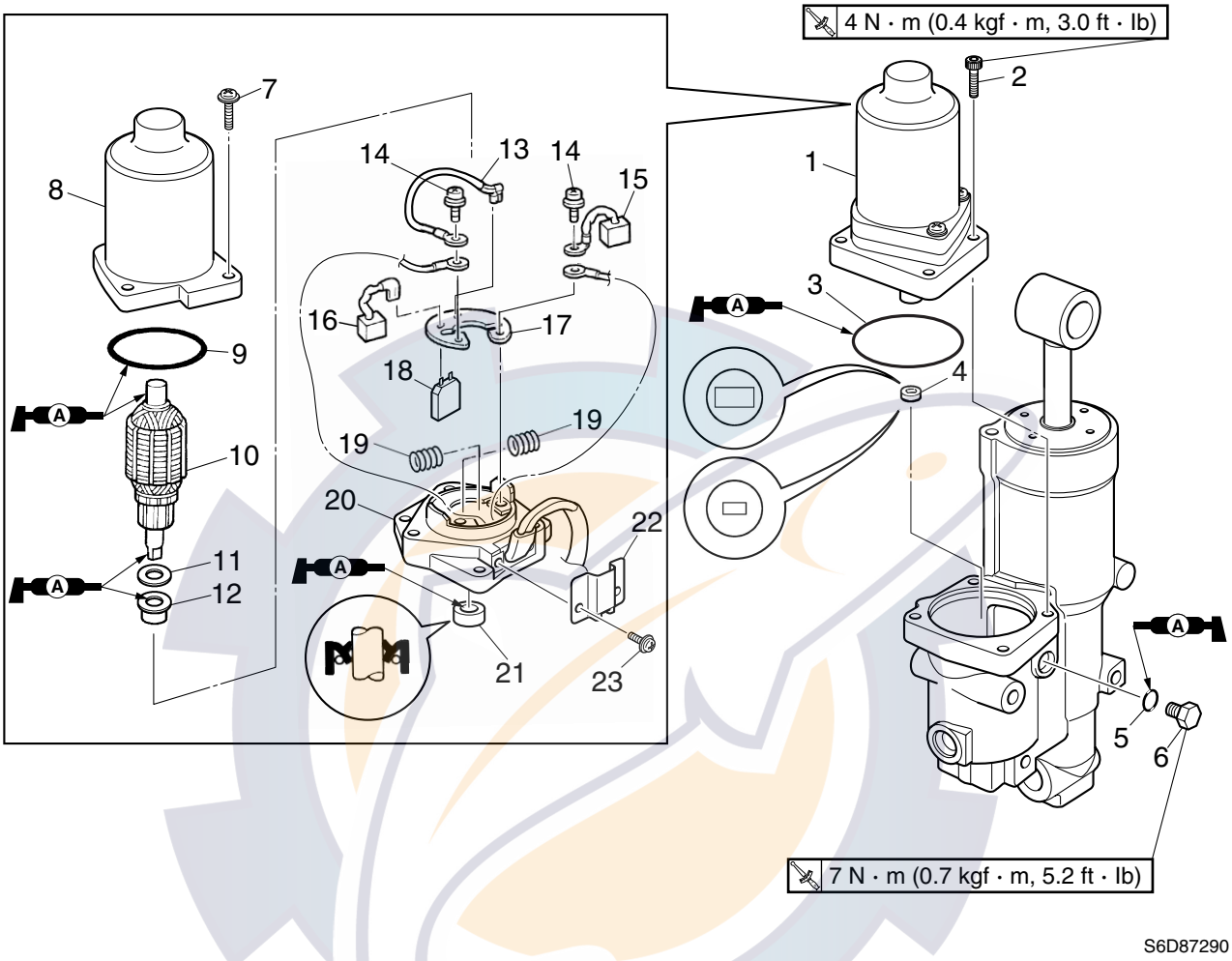
Power trim and tilt motor



S6D87290

No.	Part name	Q'ty	Remarks
1	Power trim and tilt motor	1	
2	Bolt	4	M6 × 20 mm
3	O-ring	1	**Not reusable**
4	Joint	1	
5	O-ring	1	**Not reusable**
6	Reservoir cap	1	
7	Screw	3	ø5 × 25 mm
8	Stator	1	
9	O-ring	1	**Not reusable**
10	Armature	1	
11	Washer	1	
12	Bushing	1	
13	Wire lead	1	
14	Screw	2	ø4 × 15 mm
15	Brush	1	
16	Brush	1	
17	Brush holder	1	

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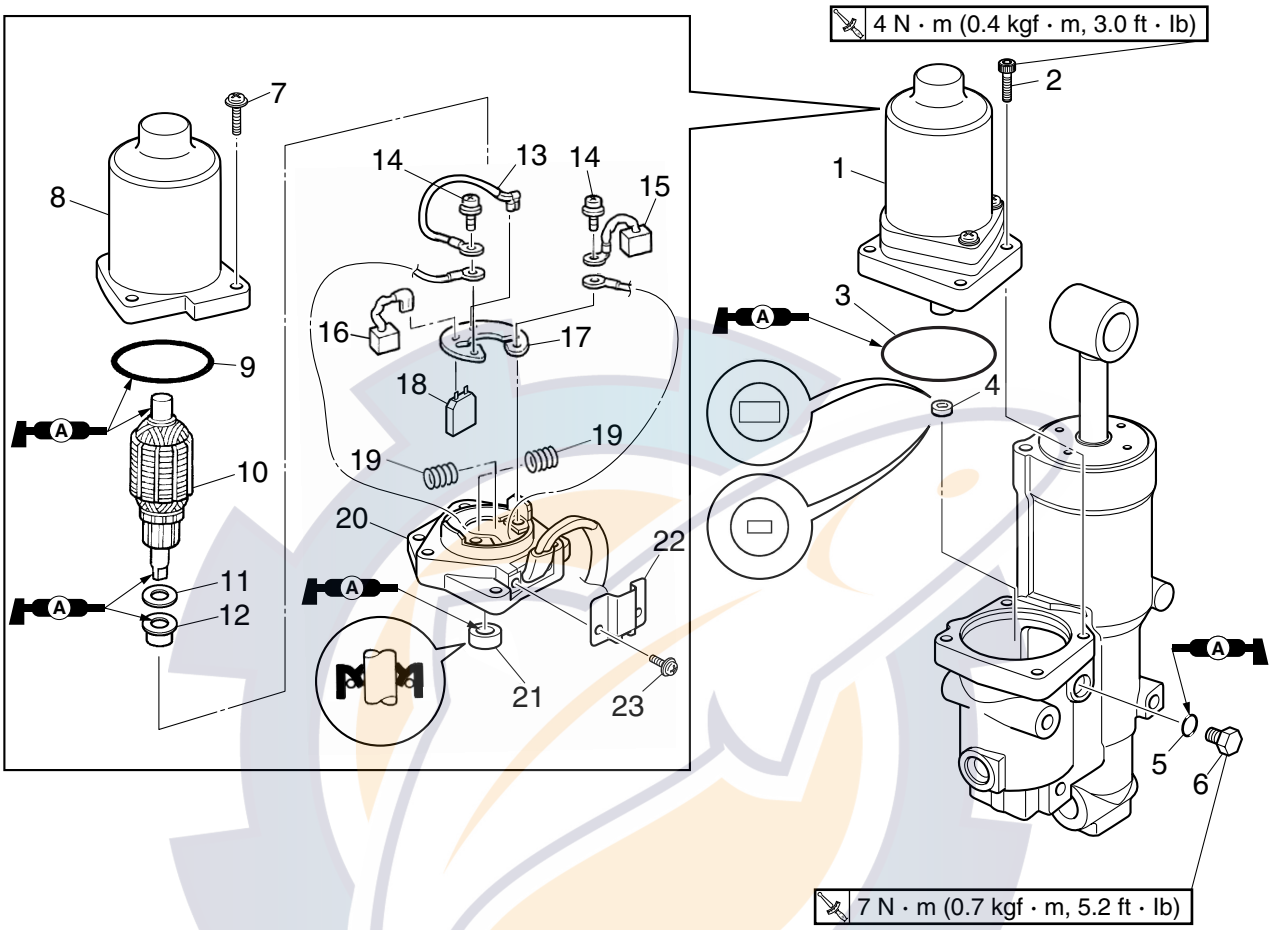

No.	Part name	Q'ty	Remarks
18	Circuit breaker	1	
19	Spring	2	
20	PTT motor base	1	
21	Oil seal	1	**Not reusable**
22	Plate	1	
23	Screw	2	ø4 × 10 mm

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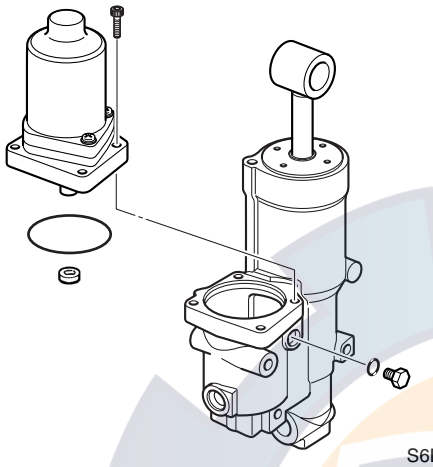
Disassembling the power trim and tilt motor

1. Remove the power trim and tilt motor, O-ring, and joint from the power trim and tilt unit.

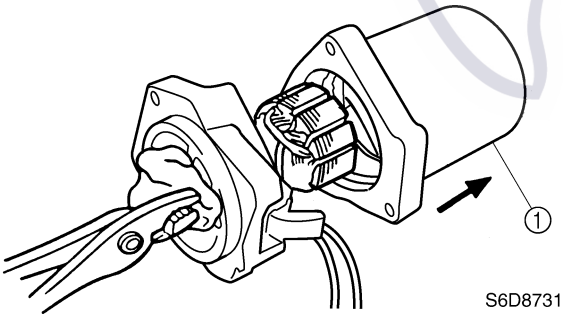


S6D87300

CAUTION:

- **Make sure that the tilt ram is fully extended when removing the power trim and tilt motor, otherwise fluid can spurt out from the unit due to internal pressure.**
- **Do not push the tilt ram down while the power trim and tilt motor is removed from the power trim and tilt unit, otherwise fluid can spurt out.**

2. Remove the stator ①.



S6D87310

NOTE:

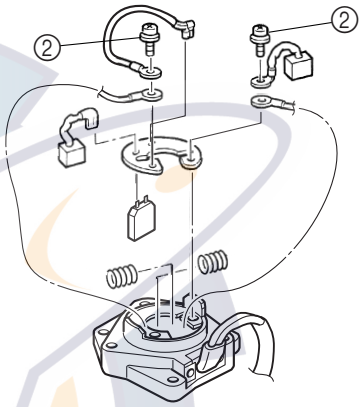
Place a clean cloth over the end of the armature shaft, hold it with a pair of pliers, and then carefully slide the stator off of the armature.

3. Remove the armature from the PTT motor base.

CAUTION:

Do not allow grease or oil to contact the commutator.

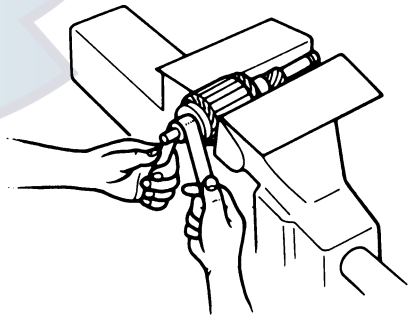
4. Remove the screws ②, and then disassemble the PTT motor base.



S6D87320

Checking the power trim and tilt motor

1. Check the commutator for dirt. Clean with 600–grit sandpaper and compressed air if necessary.



S69J8390

2. Measure the commutator diameter. Replace the armature if below specification.

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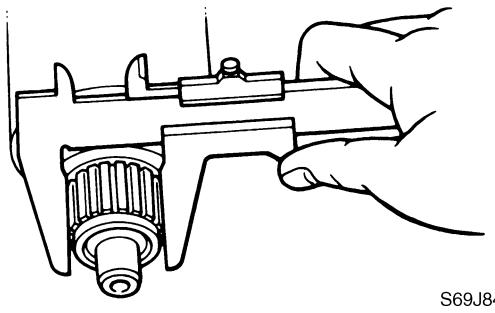
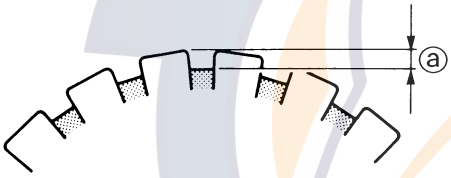


S69J8400

Commutator diameter wear limit:
21.0 mm (0.83 in)

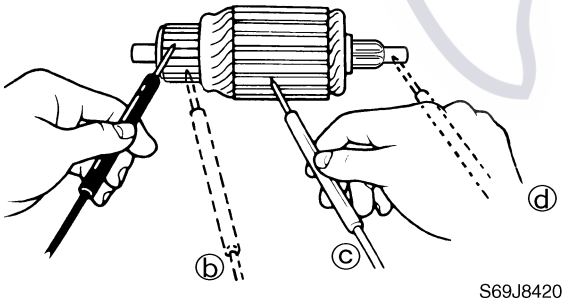
3. Measure the commutator undercut ⓐ. Replace the armature if below specification.



S69J8410

Commutator undercut wear limit ⓐ:
1.0 mm (0.04 in)

4. Check the armature for continuity. Replace if out of specifications.

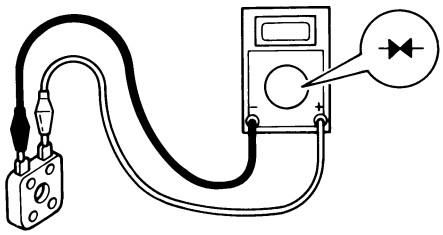


S69J8420

Armature continuity

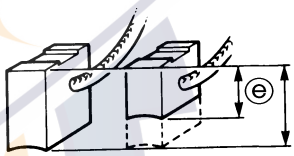
Commutator segments ⓑ	Continuity
Segment – Armature core ⓒ	No continuity
Segment – Armature shaft ⓓ	No continuity

5. Check the circuit breaker for continuity. Replace if there is no continuity.



S62Y7930

6. Measure the brush length. Replace if below specification.

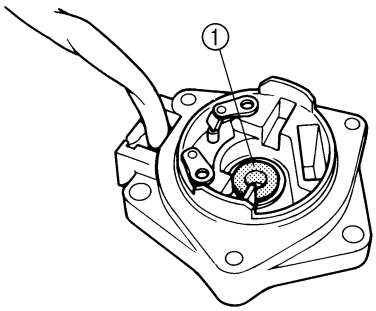


S62Y7940

Brush length wear limit ⓔ:
3.5 mm (0.14 in)

7. Check the base for cracks or damage. Replace if necessary.

8. Check the bushing ① and oil seal for damage or wear. Replace if necessary.



S62Y7950

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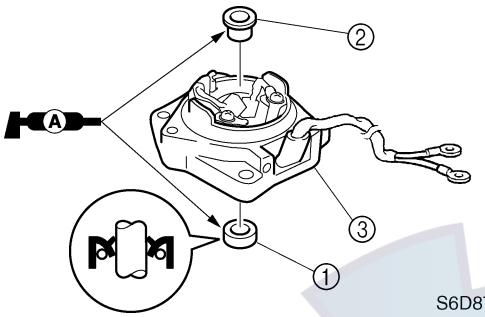
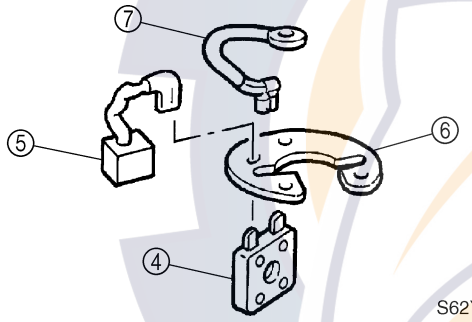
Assembling the power trim and tilt motor

1. Install a new oil seal ① and the bushing ② into the motor base ③ as shown.



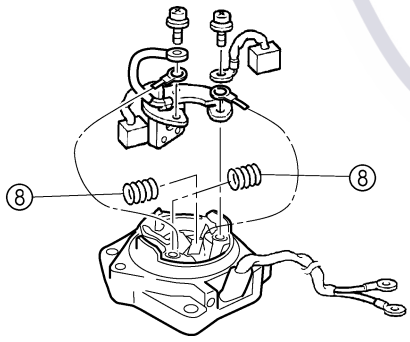
S6D87330

2. Attach the circuit breaker ④ onto the brush ⑤ together with the brush holder ⑥ and connect the wire lead ⑦.



S62Y7970

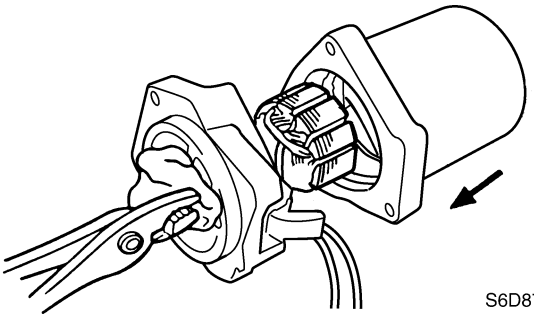
3. Install the springs ⑧ into the motor base, then the brush holder into the motor base together with the brushes and circuit breaker.



S6D87340

4. Push the brushes into the brush holder, and then install the armature.

5. Install the stator onto the base.


S6D87350

NOTE:

Place a clean cloth over the end of the armature shaft, hold it with a pair of pliers, and then carefully slide the stator over the armature.

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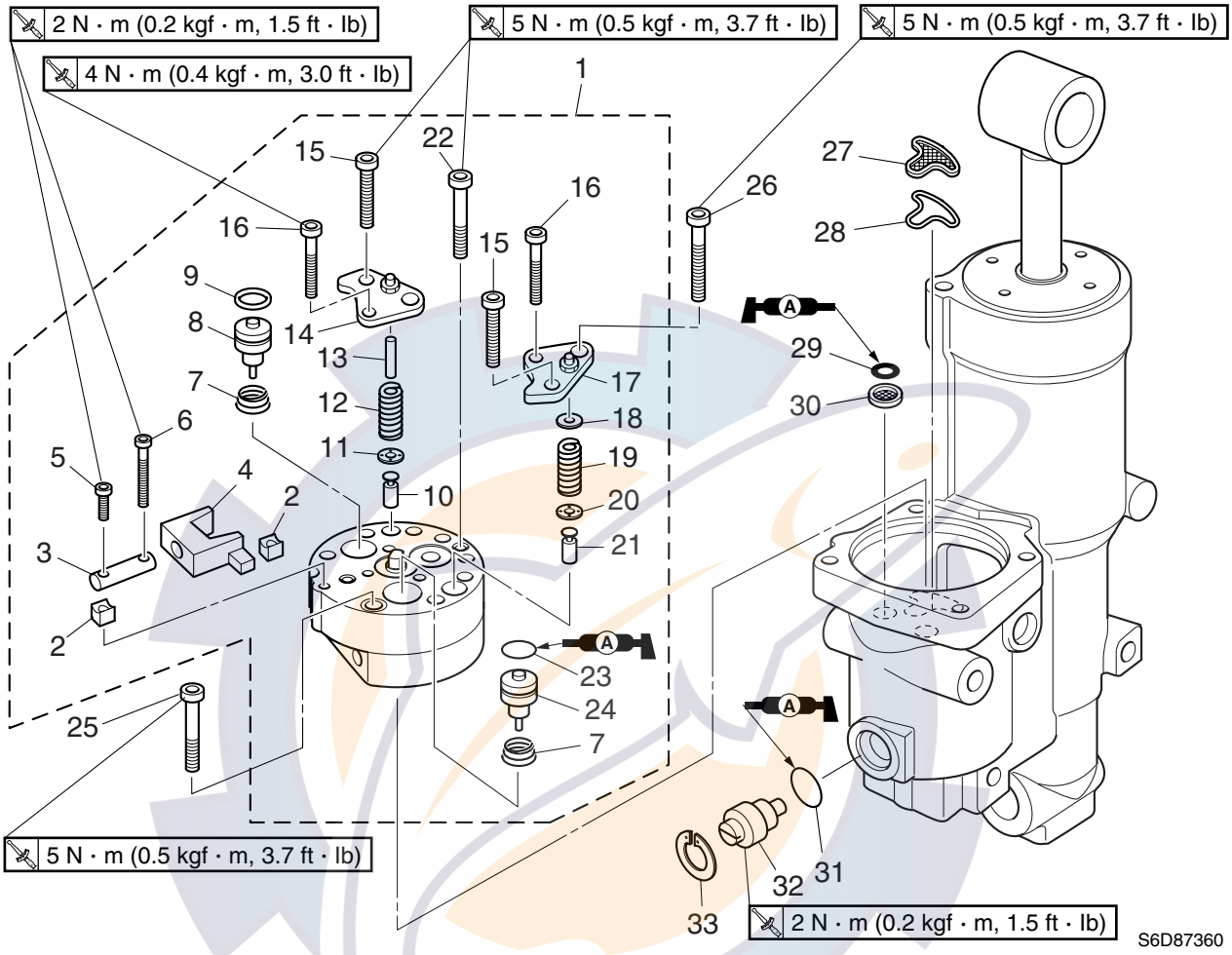
Gear pump



No.	Part name	Q'ty	Remarks
1	Gear pump assembly	1	
2	Spacer	2	
3	Pin	1	
4	Lever	1	
5	Bolt	1	M3 × 16 mm
6	Bolt	1	M3 × 35 mm
7	Spring	2	
8	Shuttle piston	1	
9	Backup ring	1	
10	Down-relief valve seat	1	
11	Washer	1	
12	Spring	1	
13	Pin	1	
14	Cap	1	
15	Bolt	2	M5 × 30 mm
16	Bolt	2	M4 × 30 mm
17	Cap	1	

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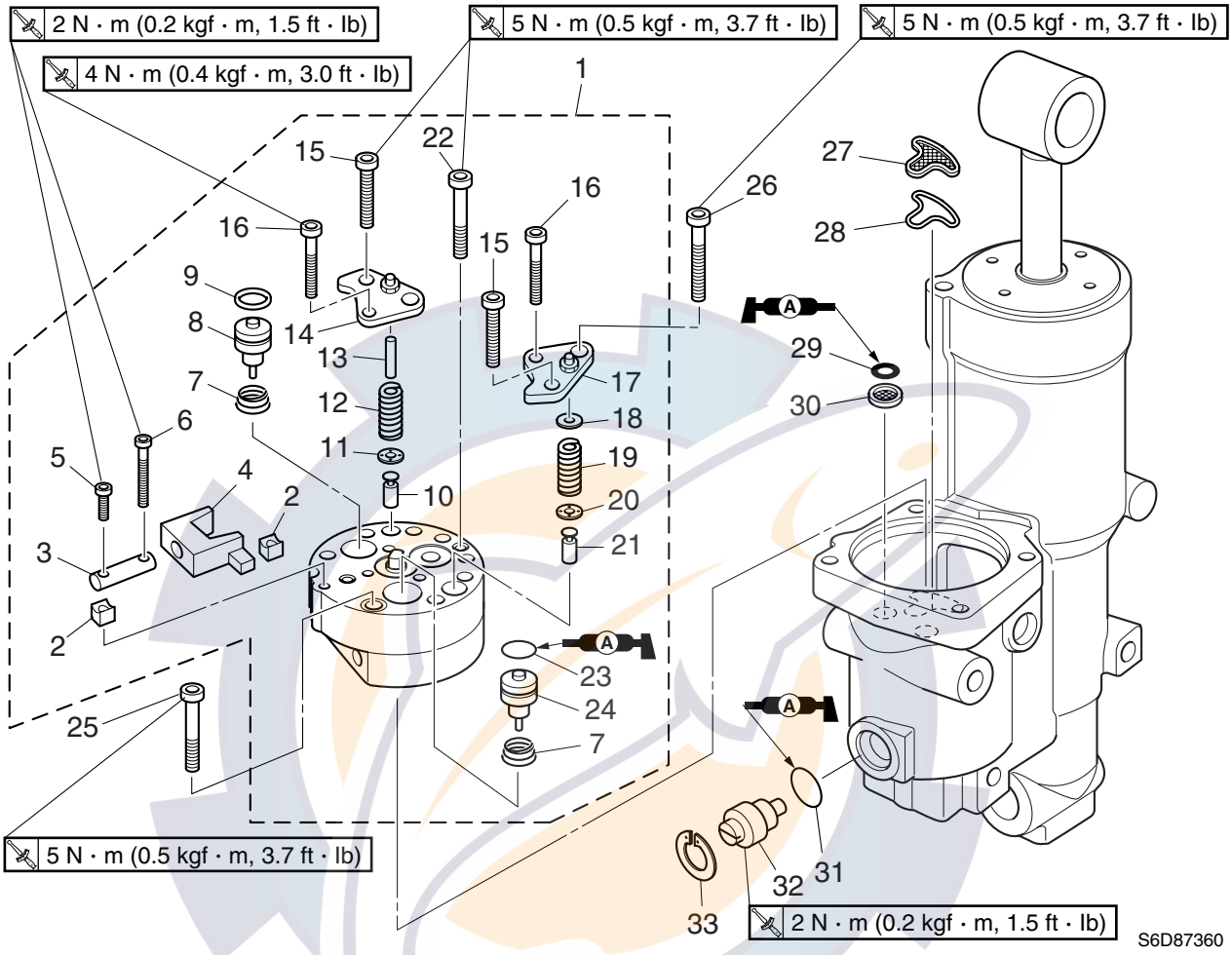

No.	Part name	Q'ty	Remarks
18	Holder	1	
19	Spring	1	
20	Washer	1	
21	Up-relief valve seat	1	
22	Bolt	2	M5 × 25 mm
23	O-ring	1	**Not reusable**
24	Shuttle piston	1	
25	Bolt	2	M5 × 45 mm
26	Bolt	2	M5 × 50 mm
27	Filter	1	
28	Plate	1	
29	O-ring	2	**Not reusable**
30	Filter	2	
31	O-ring	1	**Not reusable**
32	Manual valve	1	
33	Circlip	1	

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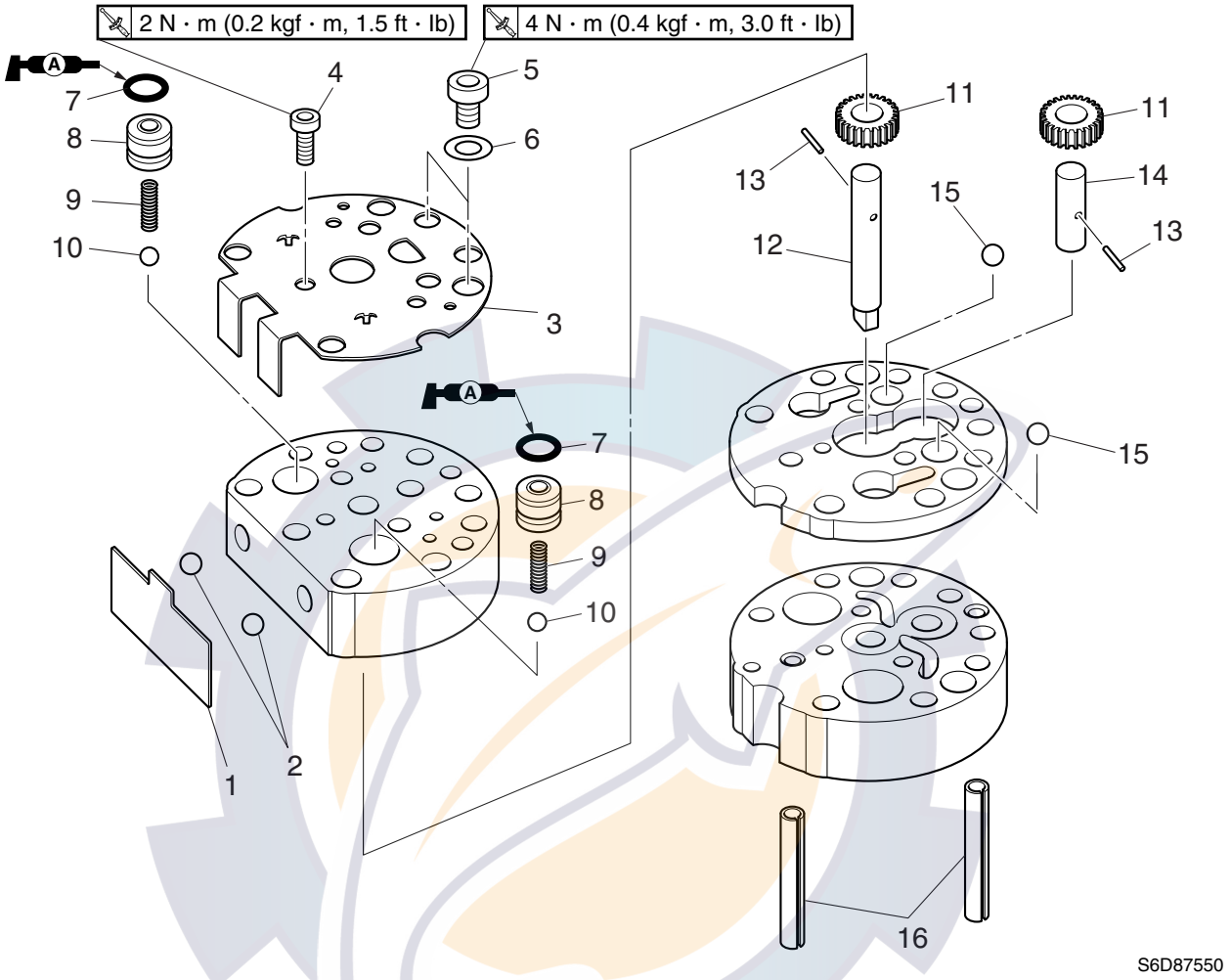

No.	Part name	Q'ty	Remarks
1	Manual release spring	1	
2	Ball	2	
3	Bracket	1	
4	Bolt	1	M3 × 5 mm
5	Bolt	2	M5 × 6 mm
6	Washer	2	
7	O-ring	2	**Not reusable**
8	Adapter	2	
9	Spring	2	
10	Ball	2	
11	Gear	2	
12	Drive shaft	1	
13	Pin	2	
14	Driven shaft	1	
15	Ball	2	
16	Pin	2	

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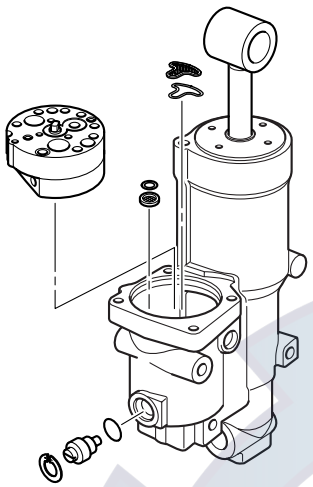
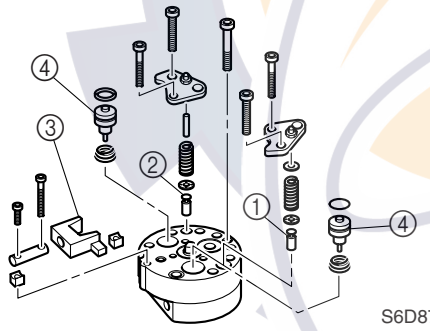
Disassembling the gear pump

1. Remove the manual valve, then the gear pump and filters.


S6D87370

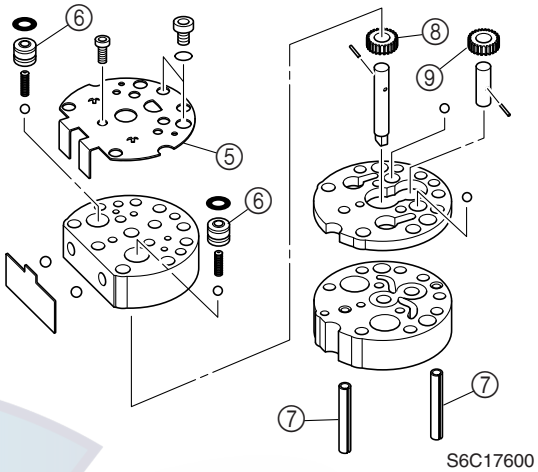
2. Remove the relief valve seat caps, then the up-relief valve seat ① and down-relief valve seat ②.

3. Remove the lever ③, then the shuttle pistons ④.


S6D87560

4. Remove the gear pump bracket ⑤, then the adapters ⑥.

5. Remove the pins ⑦, then the drive gear ⑧ and driven gear ⑨.


S6C17600

Checking the gear pump

1. Clean all the pistons and balls, and then check them for damage or wear. Replace if necessary.

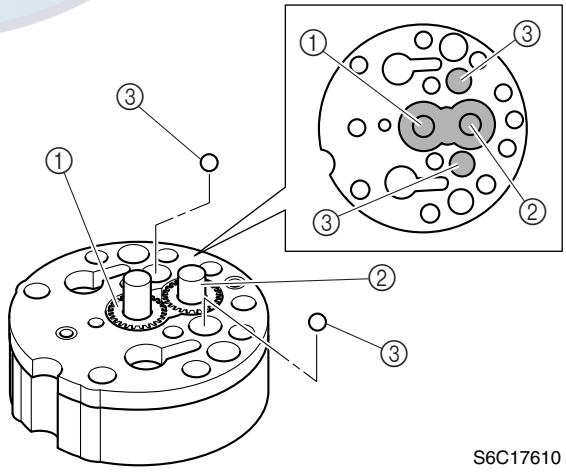
2. Check the filters for damage or clogs. Replace if necessary.

3. Check the drive gear and driven gear for damage or wear. Replace the gear pump assembly if necessary.

Assembling the gear pump

1. Install the drive gear ① and driven gear ② into the gear pump housing.

2. Install the balls ③ into the gear pump housing.


S6C17610

3. Install the gear pump cover ④, then the pins ⑤.

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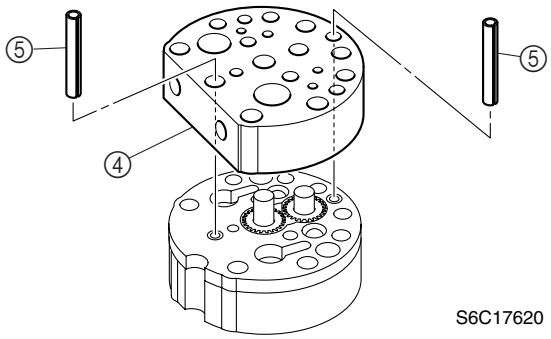
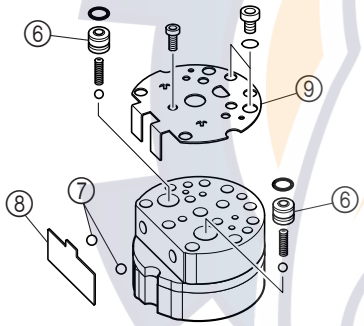


S6C17620

4. Install the adapters ⑥ into the gear pump cover.

5. Install the balls ⑦ into the gear pump cover with the manual release spring ⑧.

6. Install the gear pump bracket ⑨ by installing the bolts, then tightening them to the specified torques.

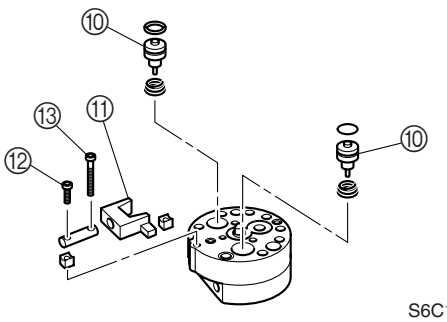


S6C17630

Gear pump bracket bolt (M3):
2 N·m (0.2 kgf·m, 1.5 ft·lb)
Gear pump bracket bolt (M5):
4 N·m (0.4 kgf·m, 3.0 ft·lb)

7. Install the shuttle pistons ⑩, then the lever ⑪.

8. Tighten bolts ⑫ and ⑬ to the specified torque.



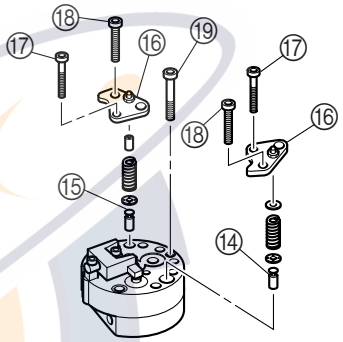
S6C17640

Lever bolt (M3) ⑫, ⑬:
2 N·m (0.2 kgf·m, 1.5 ft·lb)

9. Install the up-relief valve seat ⑭ and down-relief valve seat ⑮.

10. Install the relief valve seat caps ⑯ by installing bolts ⑰ and ⑱, then tightening them to the specified torques.

11. Tighten the bolts ⑲ to the specified torque.



S6D87380

Relief valve cap bolt (M4) ⑰:
4 N·m (0.4 kgf·m, 3.0 ft·lb)
Relief valve cap bolt (M5) ⑱:
5 N·m (0.5 kgf·m, 3.7 ft·lb)
Gear pump housing bolt ⑲:
5 N·m (0.5 kgf·m, 3.7 ft·lb)

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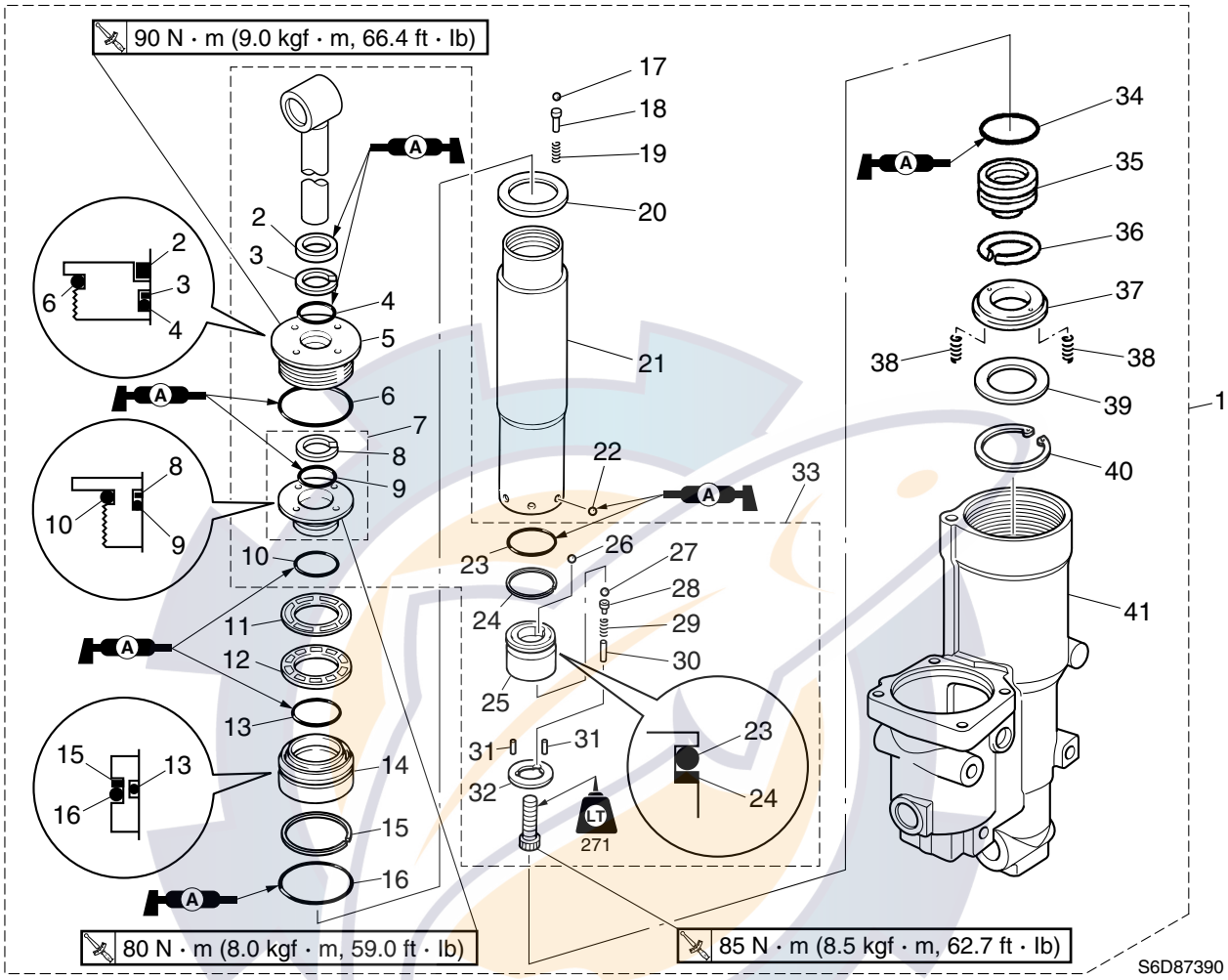
Tilt cylinder and trim cylinder



No.	Part name	Q'ty	Remarks
1	Power trim and tilt assembly	1	
2	Dust seal	1	Not reusable
3	Backup ring	1	
4	O-ring	1	Not reusable
5	Trim cylinder end screw	1	
6	O-ring	1	Not reusable
7	Tilt cylinder end screw assembly	1	
8	Backup ring	1	
9	O-ring	1	Not reusable
10	O-ring	1	Not reusable
11	Washer	1	
12	Filter	1	
13	O-ring	1	Not reusable
14	Trim piston	1	
15	Backup ring	1	
16	O-ring	1	Not reusable
17	Ball	5	

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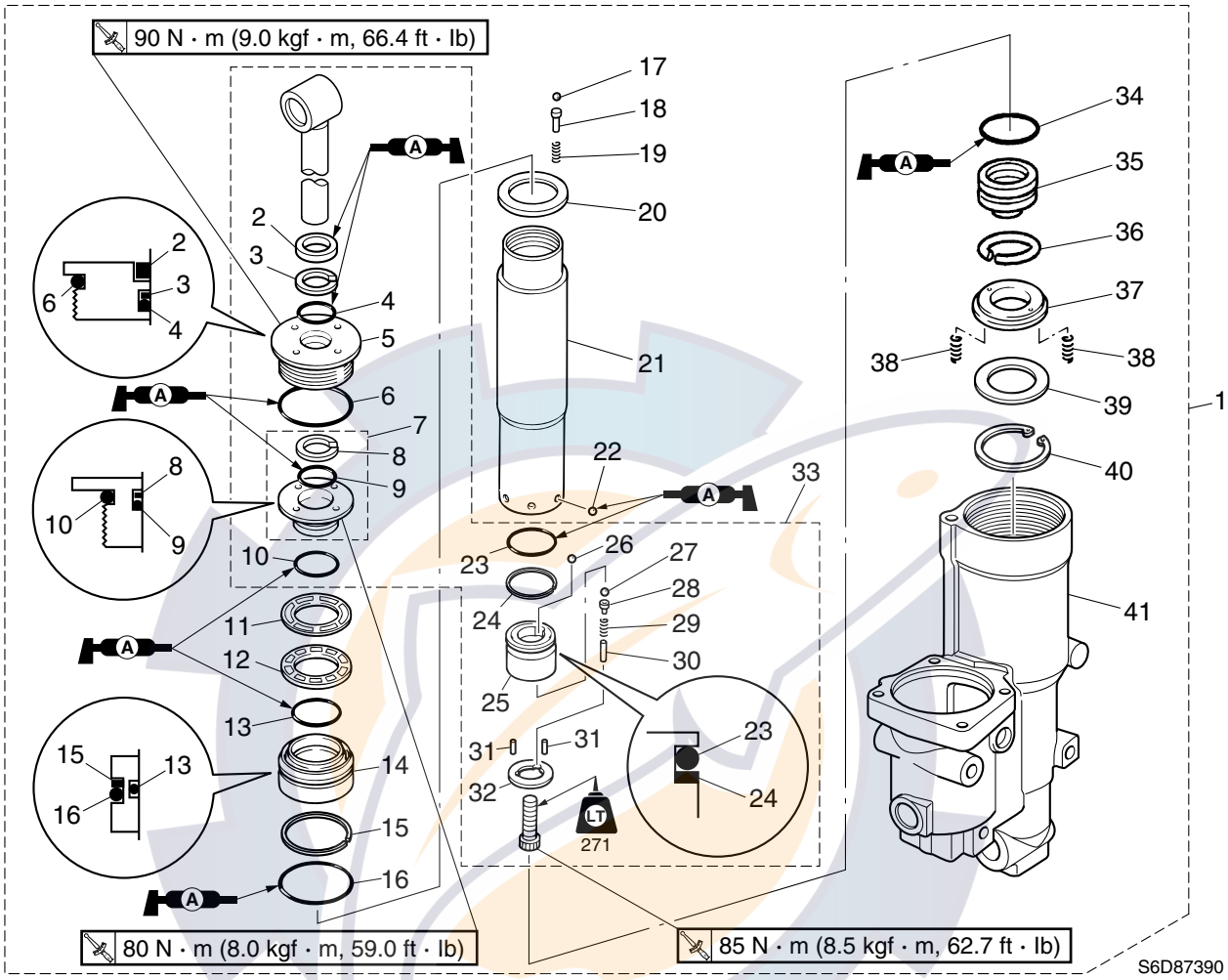

No.	Part name	Q'ty	Remarks
18	Valve	5	
19	Spring	5	
20	Washer	1	
21	Tilt cylinder	1	
22	Ball	6	
23	O-ring	1	**Not reusable**
24	Backup ring	1	
25	Tilt piston	1	
26	Ball	1	
27	Ball	2	
28	Valve	2	
29	Spring	2	
30	Pin	2	
31	Dowel	2	
32	Washer	1	
33	Tilt piston assembly	1	
34	O-ring	1	**Not reusable**

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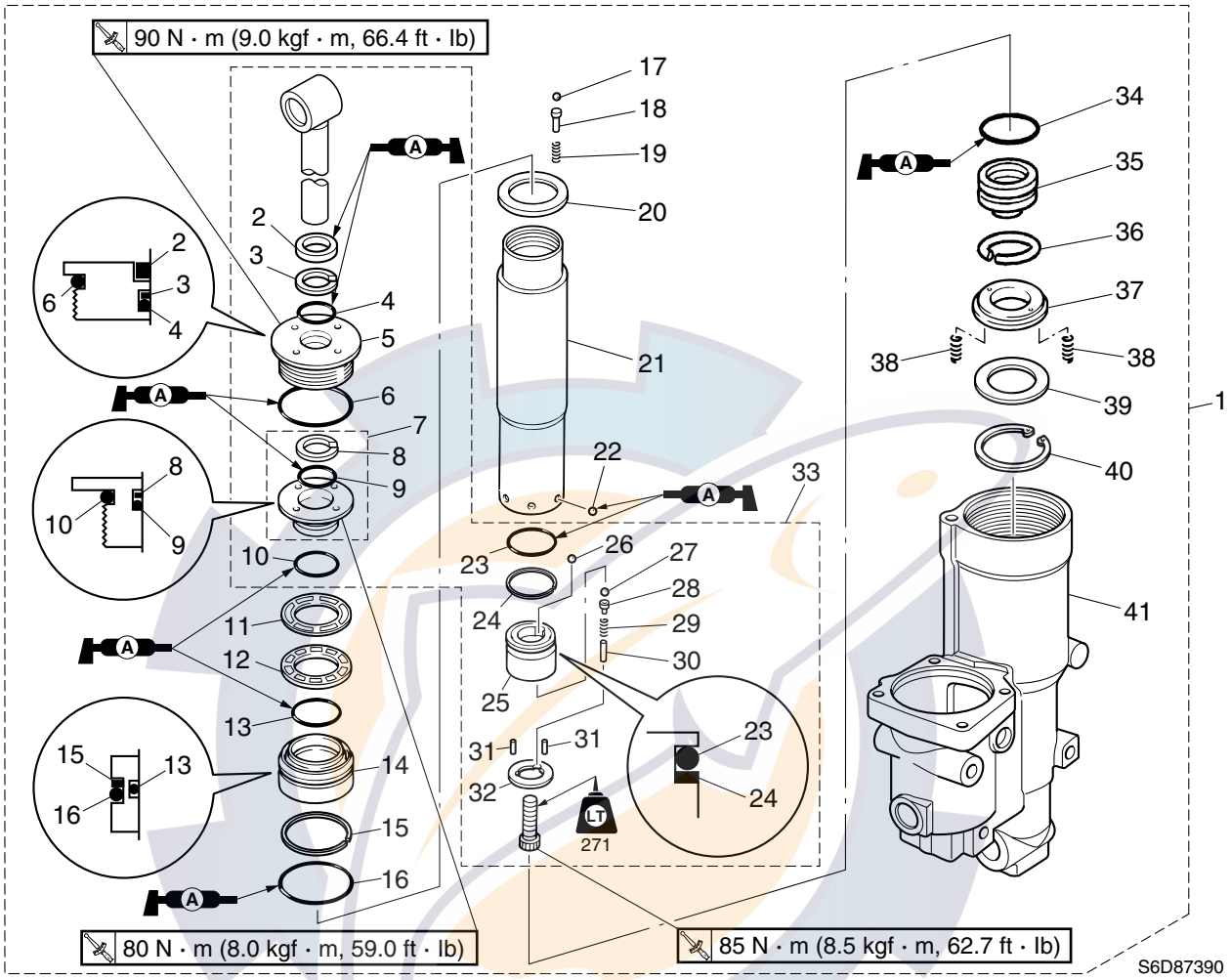

No.	Part name	Q'ty	Remarks
35	Free piston	1	
36	Circlip	1	
37	Cylinder base	1	
38	Spring	2	
39	Washer	1	
40	Circlip	1	
41	Trim cylinder	1	

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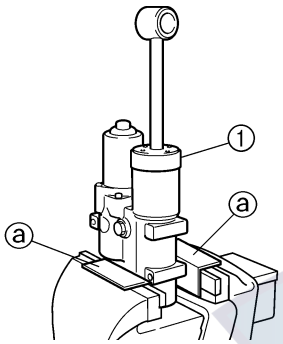
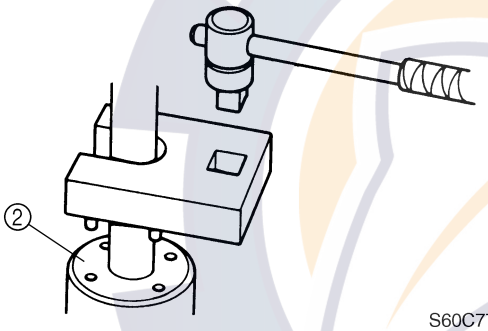
Disassembling the trim cylinder

1. Hold the power trim and tilt unit ① in a vise using aluminum plates ⓐ on both sides.



S62Y7500

2. Loosen the trim cylinder end screw ②, and then remove it.



S60C7765

⚠ WARNING

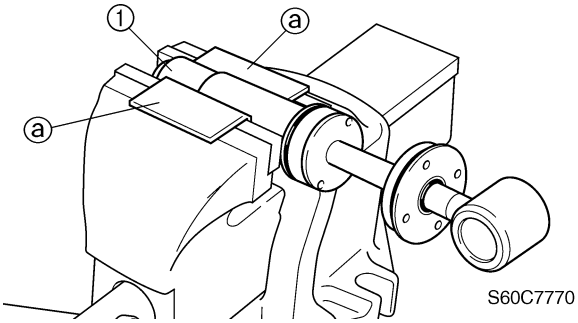
Make sure that the ram is fully extended before removing the end screw.

Trim cylinder wrench:
YB-06175-2B

3. Drain the power trim and tilt fluid.

Disassembling the tilt cylinder

1. Hold the tilt cylinder ① in a vise using aluminum plates ⓐ on both sides.

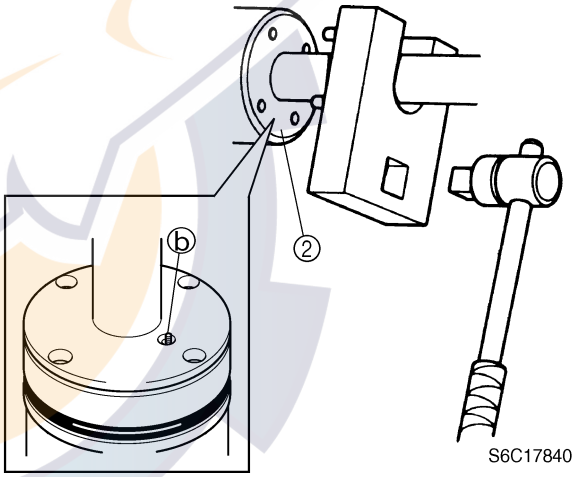


S60C7770

NOTE:

Place the tilt cylinder in the vise horizontally.

2. Loosen the tilt cylinder end screw ②, and then remove it.



S6C17840

CAUTION:

Do not damage the check valve ⓑ when loosening the end screw.

Trim cylinder wrench:
YB-06175-2B

3. Hold the tilt ram end in a vise using aluminum plates on both sides.

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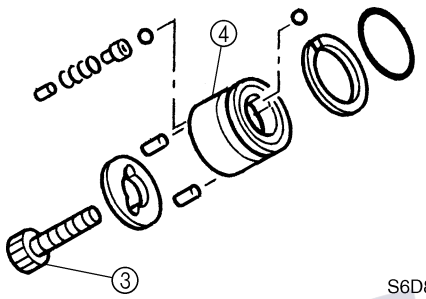
4. Remove the bolt ③, then the tilt piston ④.



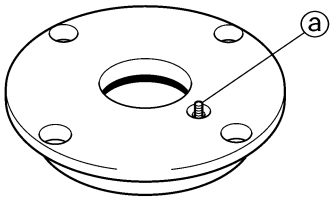
S6D87400

Checking the tilt cylinder and trim cylinder

1. Check the power trim and tilt unit for cracks or corrosion. Replace if necessary.
2. Check the inner walls of the trim cylinder and tilt cylinder for scratches. Replace if necessary.
3. Check the outer surface of the tilt piston and free piston for scratches. Replace if necessary.
4. Check the tilt ram for bends or excessive corrosion. Polish with 400- to 600-grit sandpaper if there is light rust or replace if necessary.

Checking the valves

1. Check the operation of the check valve ⓐ of the tilt cylinder end screw and check the valve for dirt or residue. Clean if necessary.

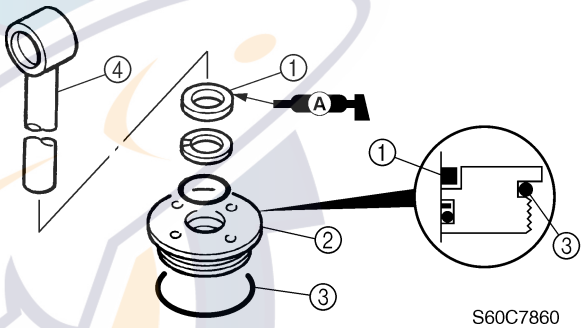


S62Y7610

2. Check the operation of the absorber valve and check for dirt or residue. Clean if necessary.

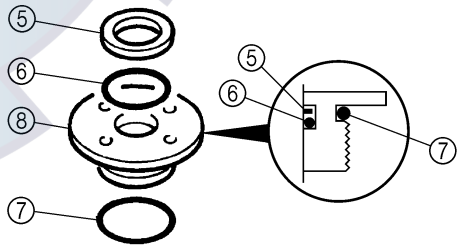
Assembling the tilt cylinder

1. Install a new O-ring, the backup ring, and a new dust seal ① into the trim cylinder end screw ②.
2. Install the O-ring ③ onto the trim cylinder end screw.
3. Install the tilt ram ④ into the trim cylinder end screw.



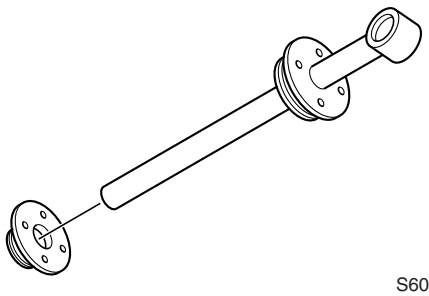
S60C7860

4. Install the backup ring ⑤ and new O-rings ⑥ and ⑦ into the tilt cylinder end screw ⑧.



S60C7865

5. Install the tilt cylinder end screw onto the tilt ram.



S60C7870

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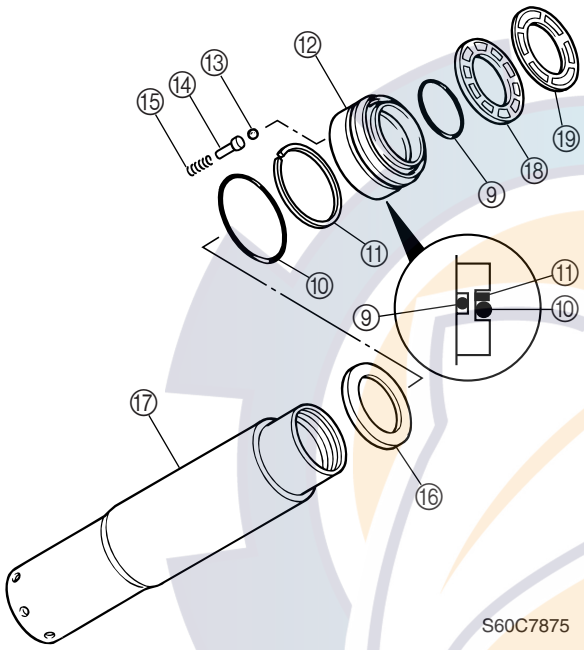
6. Install the new O-rings ⑨ and ⑩, and backup ring ⑪ onto the trim piston ⑫.

7. Install the balls ⑬, valves ⑭, and springs ⑮ into the trim piston, and then install the washer ⑯ and trim piston to the tilt cylinder ⑰.

8. Install the filter ⑱ and washer ⑲ to the trim piston.



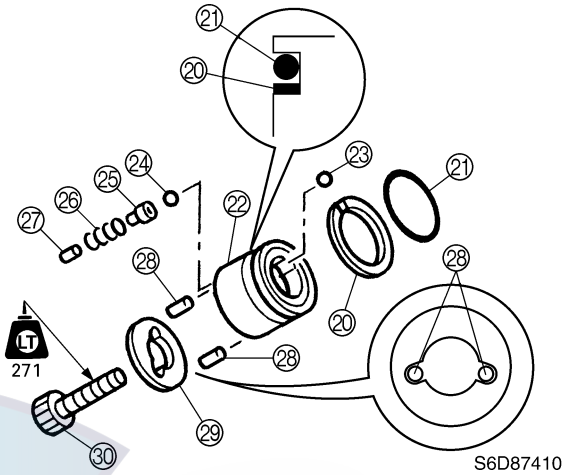
S60C7875

9. Install the backup ring ⑳ and new O-ring ㉑ to the tilt piston ㉒.

10. Install balls ㉓ and ㉔, valves ㉕, springs ㉖, pins ㉗, dowels ㉘, and washer ㉙ into the tilt piston.

11. Hold the tilt ram end in a vise using aluminum plates on both sides.

12. Install the tilt piston to the tilt ram by installing the bolt ㉚, then tightening it to the specified torque.

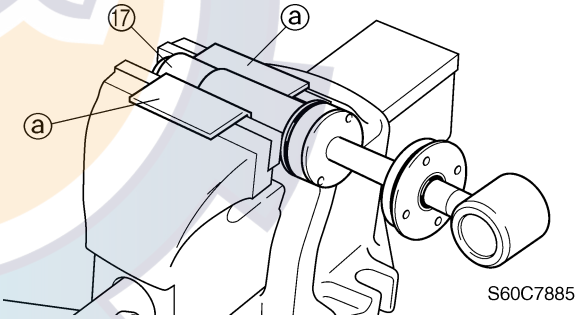


S6D87410

Tilt piston bolt ㉚:
85 N·m (8.5 kgf·m, 62.7 ft·lb)

13. Install the tilt ram into the tilt cylinder.

14. Hold the tilt cylinder ⑰ in a vise using aluminum plates ⓐ on both sides.



S60C7885

NOTE:
Place the tilt cylinder in the vise horizontally.

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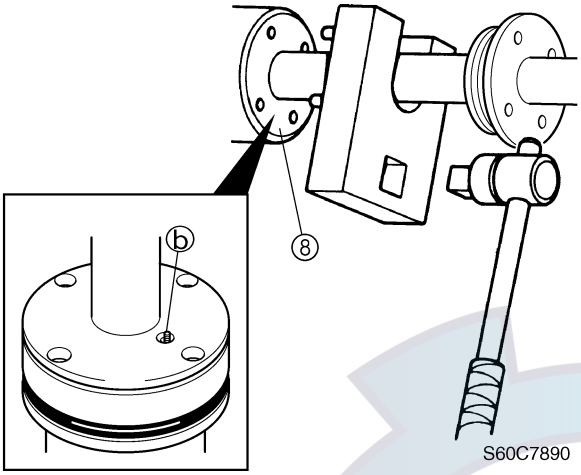
15. Install the tilt cylinder end screw ⑧, and then tighten it to the specified torque.



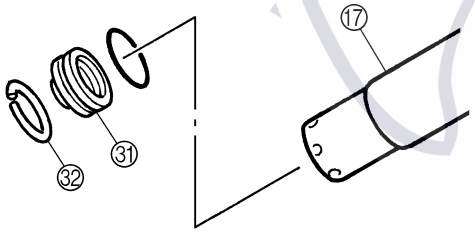
S60C7890

CAUTION:
Do not damage the check valve ⓑ when tightening the end screw.

Trim cylinder wrench: YB-06175-2B

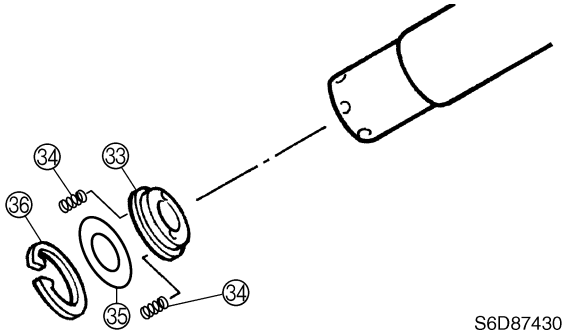
Tilt cylinder end screw ⑧:
80 N·m (8.0 kgf·m, 59.0 ft·lb)

16. Install the free piston ㉛ into the tilt cylinder ⑰ by installing the circlip ㉜.



S6D87420

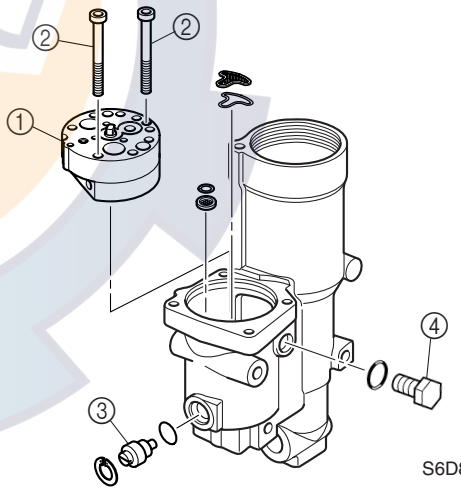
17. Install the cylinder base ㉝, springs ㉞, and washer ㉟ into the tilt cylinder with the circlip ㊱.



S6D87430

Assembling the power trim and tilt unit

1. Hold the trim cylinder in a vise using aluminum plates on both sides.
2. Install the filters and gear pump assembly ① by installing the bolts ②, then tightening them to the specified torques.
3. Install the manual valve ③ and reservoir cap ④.



S6D87440

Gear pump bolt ②:
5 N·m (0.5 kgf·m, 3.7 ft·lb)
Reservoir cap ④:
7 N·m (0.7 kgf·m, 5.2 ft·lb)

4. Fill the reservoir with the recommended fluid to the correct level as shown.

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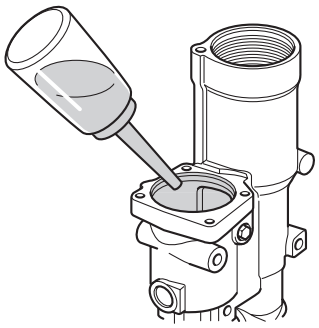
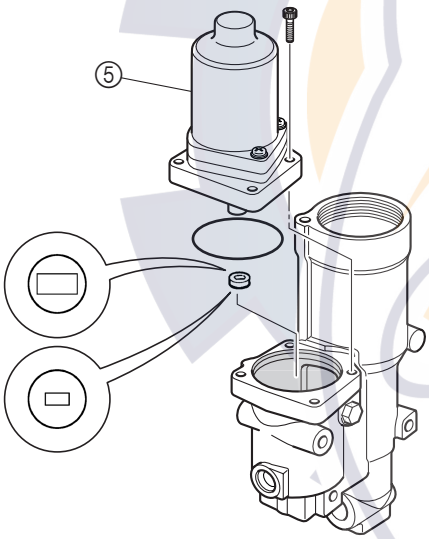


S6D87450

Recommended power trim and tilt fluid:
ATF Dexron II

5. Install a new O-ring, the joint, and the power trim and tilt motor ⑤ by installing the bolts, then tightening them to the specified torque.

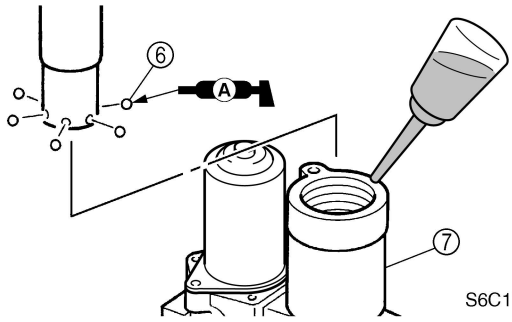


S6D87460

PTT motor bolt:
4 N·m (0.4 kgf·m, 3.0 ft·lb)

6. Add fluid of the recommended type to the first level at the bottom of the trim cylinder.

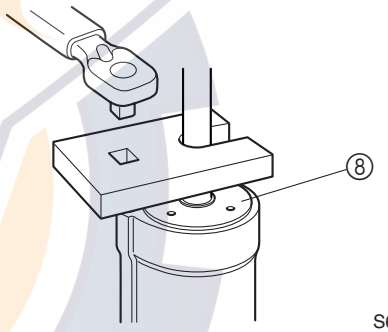
7. Install the balls ⑥ into the tilt cylinder, and then insert the tilt cylinder into the trim cylinder ⑦.



S6C17760

NOTE:
Apply grease to the balls from falling out of the cylinder installation.

8. Install the trim cylinder end screw ⑧, and then tighten it to the specified torque.



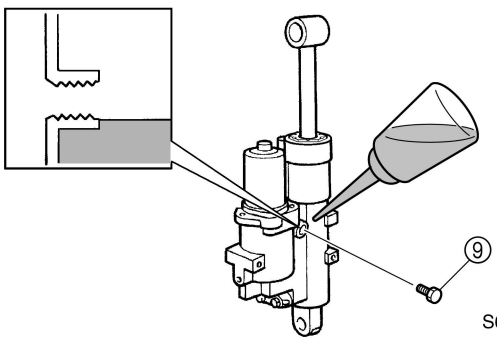
S6D87480

Trim cylinder wrench:
YB-06175-2B

Trim cylinder end screw ⑧:
90 N·m (9.0 kgf·m, 66.4 ft·lb)

9. Fully extend the tilt rod, and then add sufficient fluid of the recommended type to the correct level.

10. Install the reservoir cap ⑨.



S6C17780

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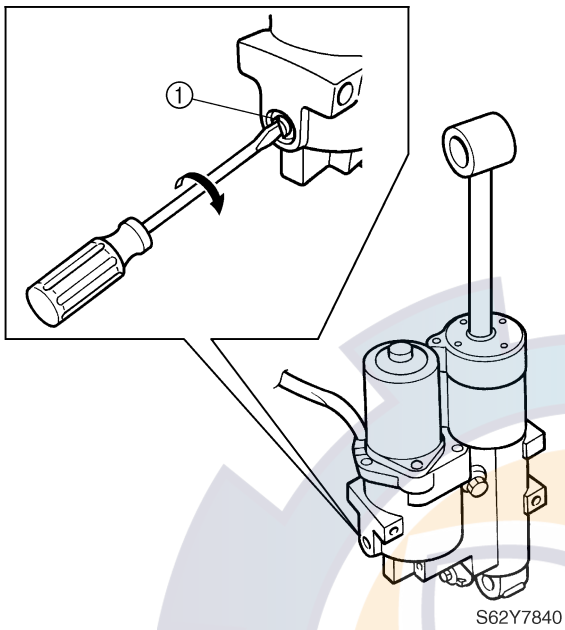
Bleeding the power trim and tilt unit

1. Tighten the manual valve ① by turning it clockwise.



S62Y7840

Manual valve ①:
2 N·m (0.2 kgf·m, 1.5 ft·lb)

2. Place the power trim and tilt unit in an upright position.

3. Remove the reservoir cap, and then check the fluid level in the reservoir.

NOTE:
If the fluid is at the correct level, the fluid should overflow out of the filler hole when the reservoir cap is removed.

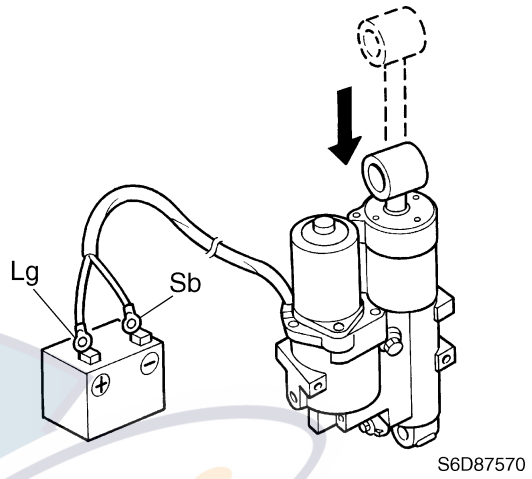
4. If necessary, add sufficient fluid of the recommended type until it overflows out of the filler hole.

Recommended power trim and tilt fluid:
ATF Dexron II

5. Install the reservoir cap, and then tighten it to the specified torque.

Reservoir cap:
7 N·m (0.7 kgf·m, 5.2 ft·lb)

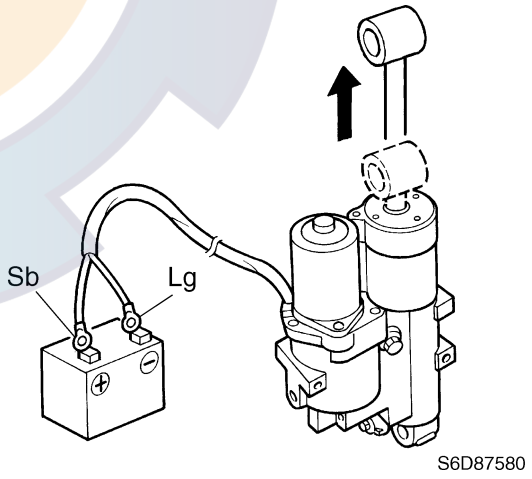
6. Connect the PTT motor leads to the battery terminals to fully retract the tilt ram.



S6D87570

Ram	PTT motor lead	Battery terminal
Down	Light green (Lg)	⊕
	Sky blue (Sb)	⊖

7. Reverse the PTT motor leads between the battery terminals to fully extend the tilt ram.



S6D87580

Ram	PTT motor lead	Battery terminal
Up	Sky blue (Sb)	⊕
	Light green (Lg)	⊖

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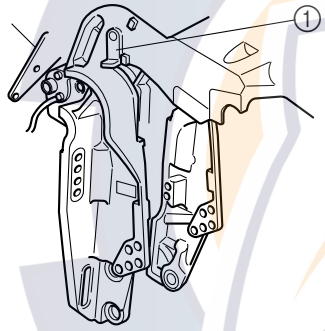
NOTE:
- Repeat this procedure so that the ram goes up and down four or five times (be sure to wait a few seconds before switching the leads).
- If the ram does not move up and down easily, push and pull on the ram to assist operation.

8. Check the fluid level when the tilt ram is fully extended. Add sufficient fluid if necessary.

Installing the power trim and tilt unit

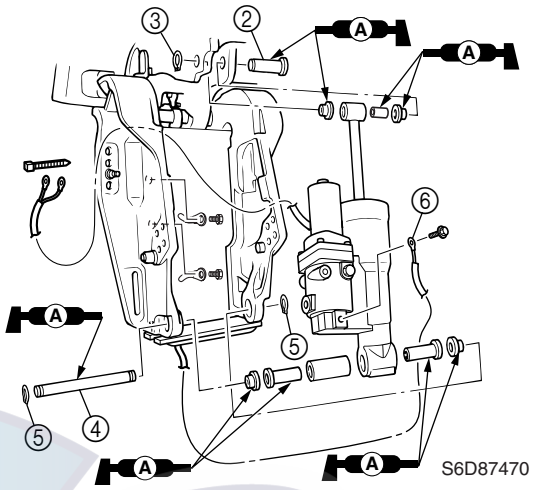
1. Fully tilt the outboard motor up, and then support it with the tilt stop lever ①.



S60C7975

CAUTION:
After tilting the outboard motor up, be sure to support it with the tilt stop lever.

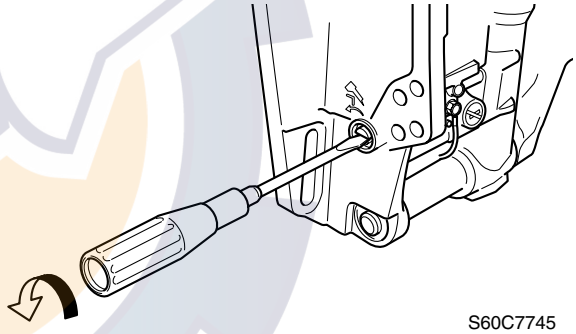
2. Install the collars and bushings.
3. Lift the power trim and tilt unit up, and then install the upper mounting shaft ②.
4. Install the circlip ③.
5. Install the lower mounting shaft ④, and then install the circlips ⑤.
6. Route the PTT motor leads through the hole, and then install the holders and plastic ties.
7. Connect the ground lead ⑥.



S6D87470

Bleeding the power trim and tilt unit (built-in)

1. Fully turn the manual valve counterclockwise.


S60C7745

2. Fully tilt the outboard motor up, and then release it to let it lower by its own weight four to five times.
3. Tighten the manual valve by turning it clockwise.

	Reservoir cap: 7 N·m (0.7 kgf·m, 5.2 ft·lb)

4. Let the fluid settle for 5 minutes.
5. Push and hold the power trim and tilt switch in the up position to check that the outboard motor is fully tilted up.

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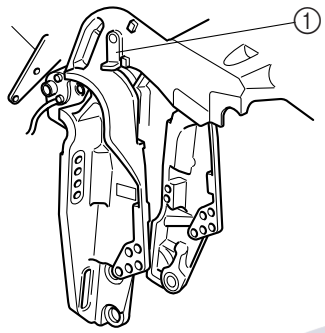
6. Support the outboard motor with the tilt stop lever ①.

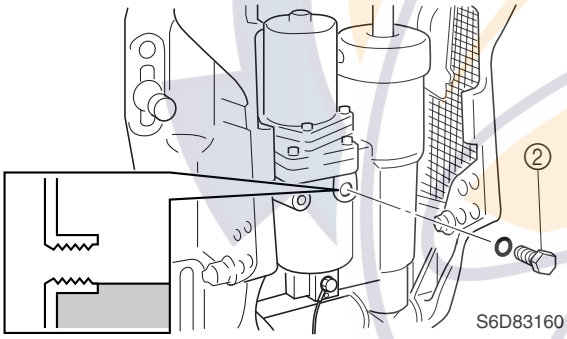


S60C7975

⚠ WARNING

After tilting up the outboard motor, be sure to support it with the tilt stop lever. Otherwise, the outboard motor could suddenly lower if the power trim and tilt unit should lose fluid pressure.

7. Remove the reservoir cap ②, and then check the fluid level in the reservoir.



S6D83160

NOTE:

If the fluid is at the correct level, the fluid should overflow out of the filler hole when the reservoir cap is removed.

8. If necessary, add sufficient fluid of the recommended type to the correct level.

Recommended power trim and tilt fluid: ATF Dexron II	

9. Install the reservoir cap, and then tighten it to the specified torque.

NOTE:

Repeat this procedure until the fluid remains at the correct level.

Reservoir cap: 7 N·m (0.7 kgf·m, 5.2 ft·lb)	

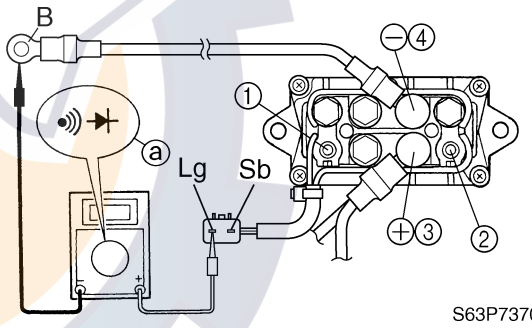
Power trim and tilt electrical system

Checking the fuse

1. Check the fuse for continuity. Replace if there is no continuity.

Checking the power trim and tilt relay

1. Check the power trim and tilt relay for continuity. Replace if out of specification.



S63P7370

NOTE:

Be sure to set the measurement range ⓐ shown in the illustration when checking for continuity.

Power trim and tilt relay continuity	
Sky blue (Sb) – Black (B) Light green (Lg) – Black (B)	Continuity
Terminal ① – Terminal ④ Terminal ② – Terminal ④	Continuity
Terminal ① – Terminal ③ Terminal ② – Terminal ③	No continuity

2. Connect the digital circuit tester between power trim and tilt relay terminals ② and ③.

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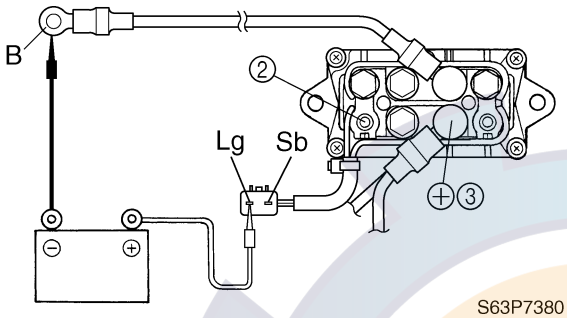
3. Connect the light green (Lg) lead to the positive battery terminal and the black (B) lead to the negative battery terminal as shown.

4. Check for continuity between terminals ② and ③. Replace if there is no continuity.

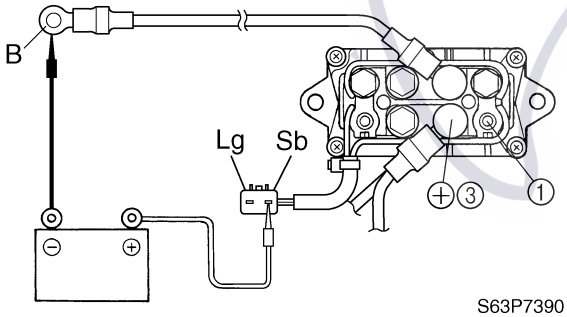


S63P7380

5. Connect the digital circuit tester between power trim and tilt relay terminals ① and ③.

6. Connect the sky blue (Sb) lead to the positive battery terminal and the black (B) lead to the negative battery terminal as shown.

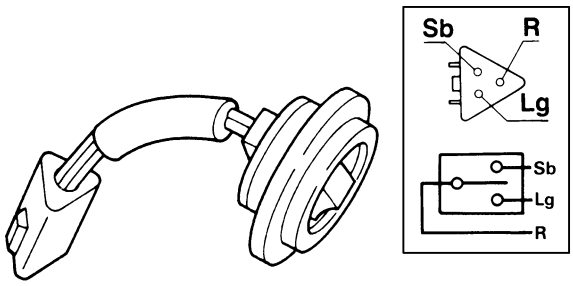
7. Check for continuity between terminals ① and ③. Replace if there is no continuity.



S63P7390

Checking the power trim and tilt switch

1. Check the power trim and tilt switch for continuity. Replace if out of specification.

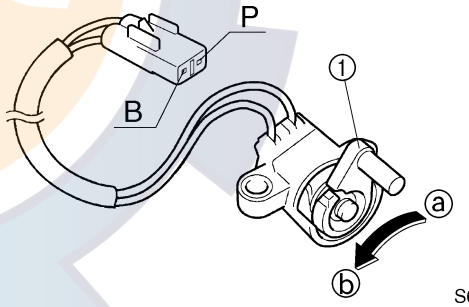


S62Y7A70

Switch position	Lead color		
	Sky blue (Sb)	Red (R)	Light green (Lg)
Up	○	—○	
Free			
Down		○—	—○

Checking the trim sensor

1. Measure the trim sensor resistance. Replace if out of specification.



S63P7290

NOTE:
Turn the lever ① and measure the resistance as it gradually changes.

Trim sensor resistance:
Pink (P) – Black (B)
238.8–378.8 Ω at 20 °C (68 °F) ⓐ
9–11 Ω at 20 °C (68 °F) ⓑ

7

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Electrical systems

Special service tools 8-1

Checking the electrical components 8-2
Measuring the peak voltage 8-2
Measuring the lower resistance 8-2

Electrical components 8-3
Port view 8-3
Starboard view 8-4
Bow view 8-5
Top view 8-6

Ignition and ignition control system 8-7
Checking the ignition spark 8-7
Checking the spark plug wires 8-7
Checking the ignition coils 8-7
Checking the ECM 8-8
Checking the pulser coils 8-8
Checking the sensor assembly 8-8
Checking the cooling water temperature sensor 8-9
Checking the oil pressure switch 8-9
Checking the shift position switch 8-9
Checking the main and fuel pump relay (main control) 8-10

Fuel control system 8-10
Checking the injectors 8-10
Checking the electric fuel pump 8-10
Checking the main and fuel pump relay (fuel control) 8-11

Starting system 8-11
Checking the fuses 8-11
Checking the starter relay 8-11

Starter motor 8-13
Disassembling the starter motor 8-15
Checking the starter motor pinion 8-15
Checking the armature 8-15
Checking the brushes 8-16
Checking the magnet switch 8-16
Checking the starter motor operation 8-16

Charging system 8-16
Checking the stator coil 8-16
Checking the Rectifier Regulator 8-17

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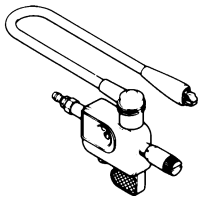
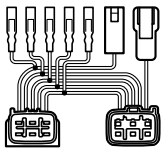
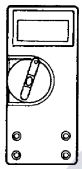
Special service tools



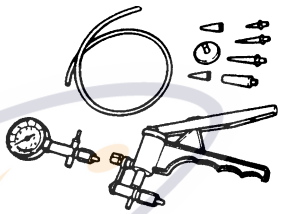
Spark checker
YM-34487



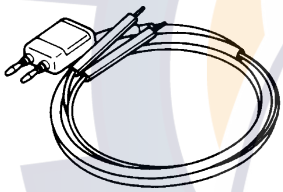
Test harness (6 pins)
YB-06848



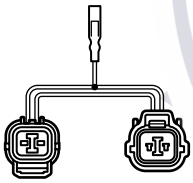
Digital multimeter
YU-34899-A



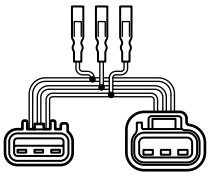
Pressure/vacuum tester
YB-35956-A



Peak volt meter adapter
YU-39991



Test harness (2 pins)
YB-06792



Test harness (3 pins)
YB-06791

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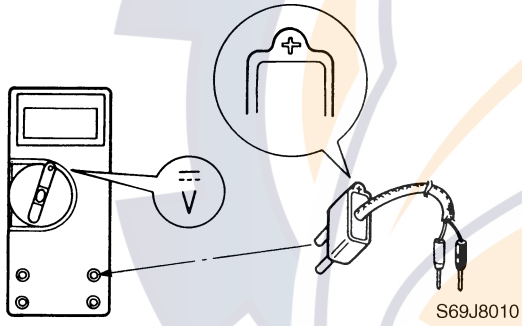
Checking the electrical components

Measuring the peak voltage

NOTE:
Before troubleshooting the peak voltage, check that all electrical connections are tight and free from corrosion, and that the battery is fully charged to 12 V.

The condition of the ignition system can be determined by measuring the peak voltage. Cranking speed is effected by many factors, such as fouled or weak spark plugs, or a weak battery. If one of these factors is present, the peak voltage will be lower than specification. In addition, if the peak voltage is lower than specification the engine will not operate properly.



S69J8010

⚠ WARNING
When checking the peak voltage, do not touch any of the connections of the digital tester leads.

NOTE:
- Use the peak voltage adapter with the digital circuit tester.
- When measuring the peak voltage, set the selector on the digital circuit tester to the **DC voltage mode**.
- Connect the positive pin on the peak voltage adapter to the positive terminal of the digital circuit tester.

Measuring the lower resistance

When measuring a resistance of 10 Ω or less with the digital circuit tester, the correct measurement cannot be obtained due to the internal resistance of the tester. To obtain the correct value, subtract the internal resistance from the displayed measurement.

NOTE:
To obtain the internal resistance of the digital circuit tester, connect both of its probes and check the display.

Correct value =
displayed measurement – internal resistance

8

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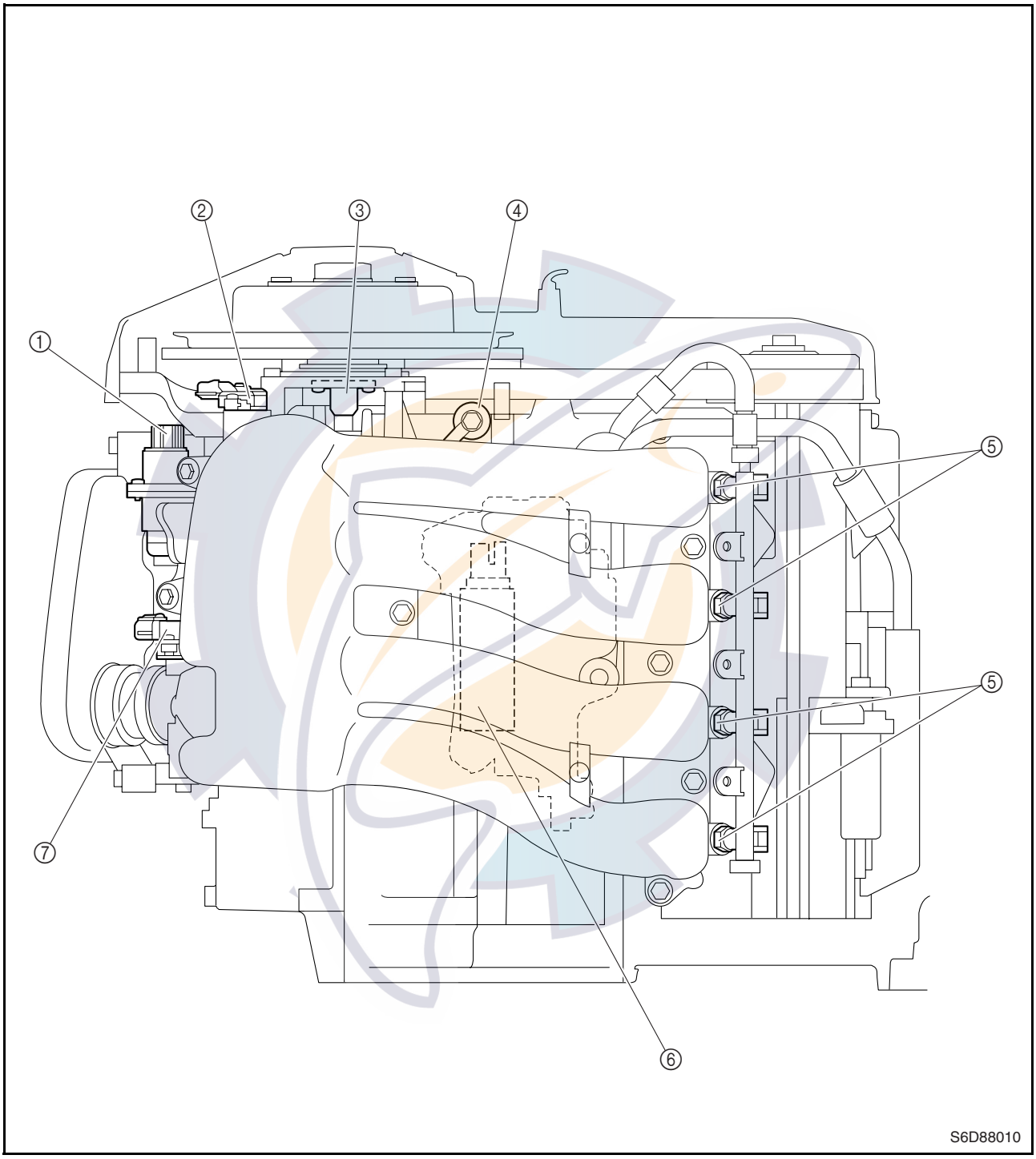
Electrical components

Port view



① Idle speed control
② Sensor assembly (intake air temperature and intake air pressure)
③ Pulser coil
④ Oil pressure switch
⑤ Fuel injector
⑥ Electric fuel pump
⑦ Throttle position sensor

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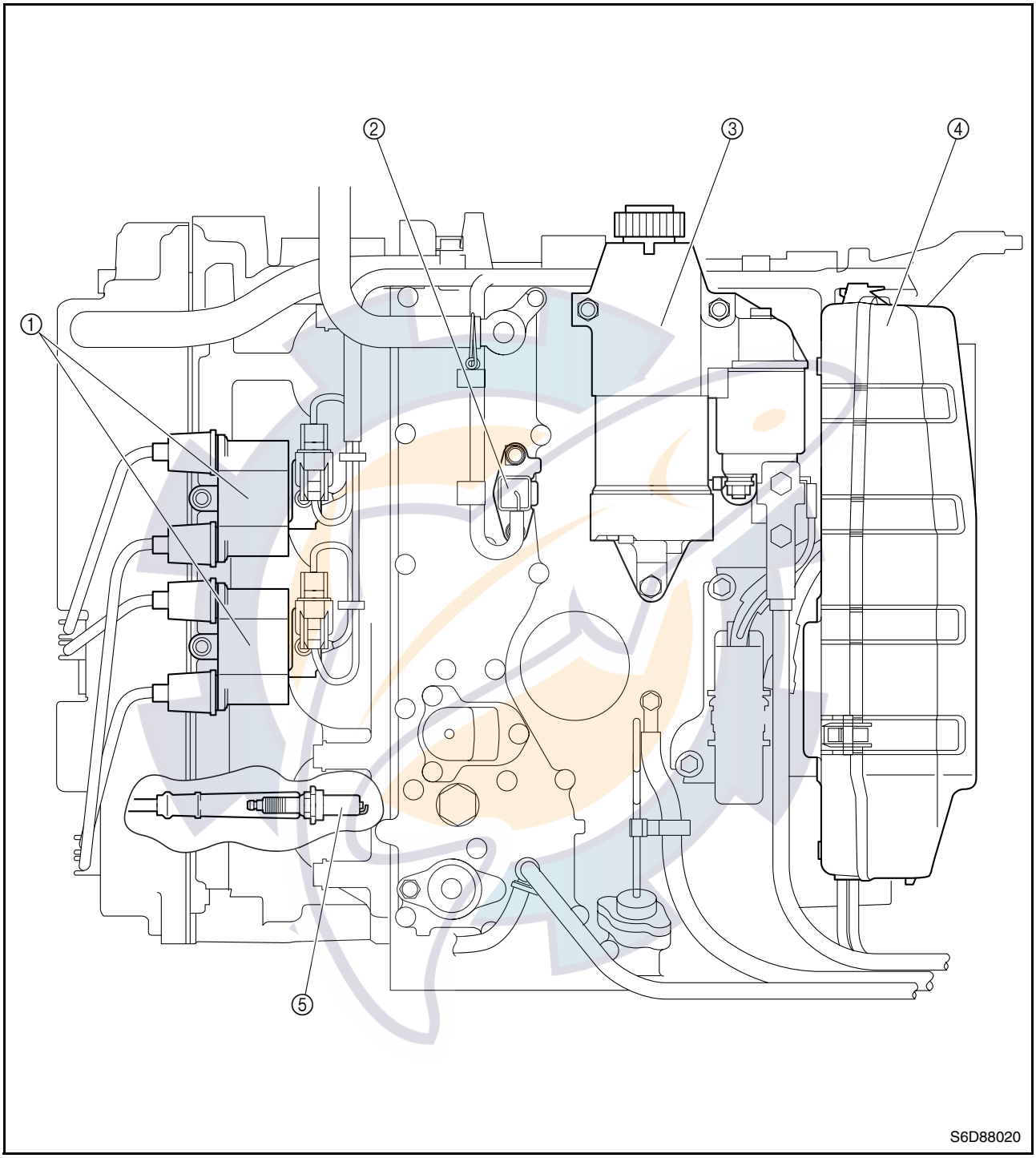
Starboard view



① Ignition coil
② Cooling water temperature sensor
③ Starter motor
④ Junction box
⑤ Spark plug

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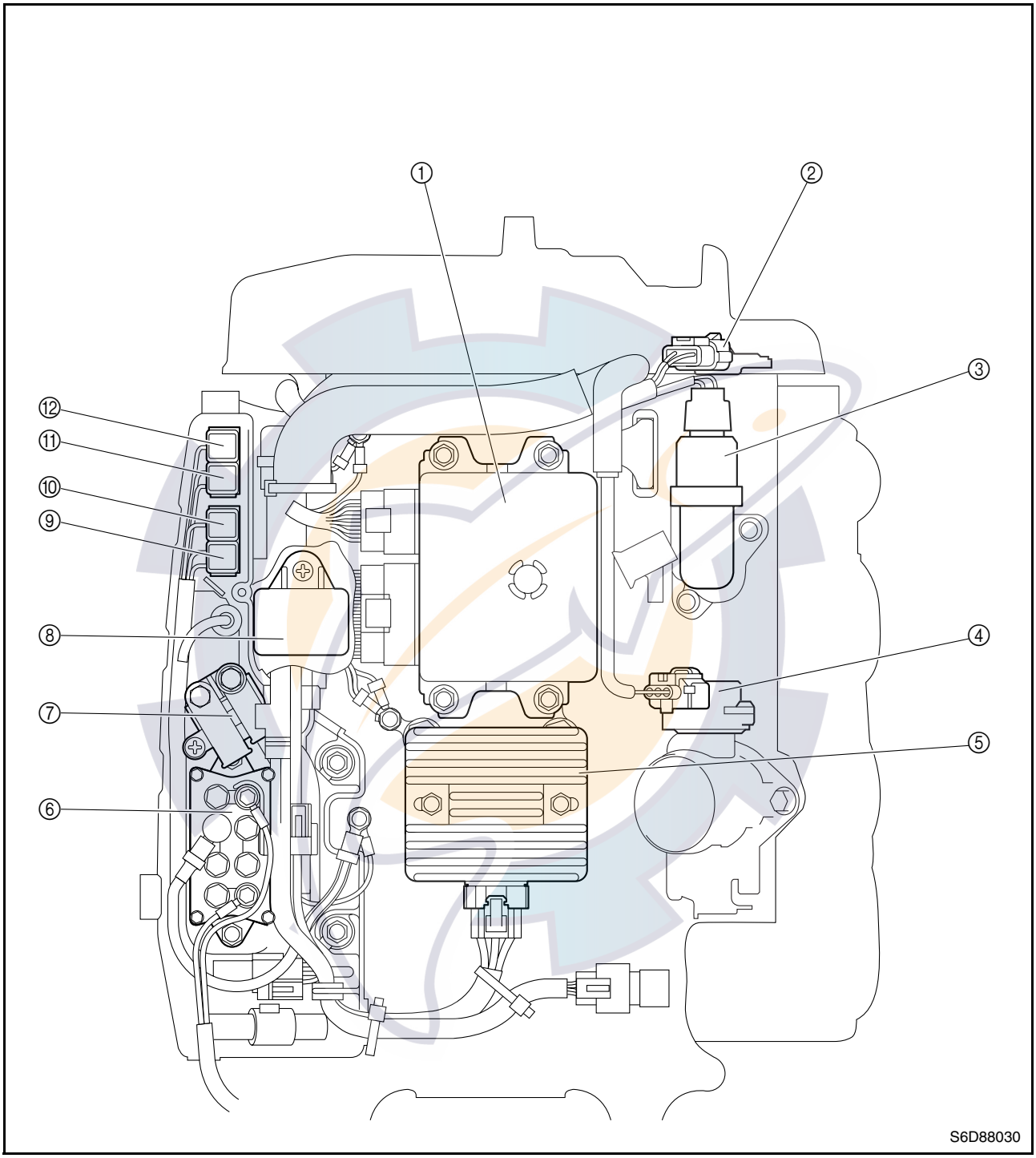
Bow view



① ECM
② Sensor assembly
(intake air temperature and intake air pressure)
③ Idle speed control
④ Throttle position sensor
⑤ Rectifier Regulator
⑥ Power trim and tilt relay
⑦ Starter relay
⑧ Main and fuel pump relay
⑨ Fuse (20A)
(ECM, ignition coil, electric fuel pump, and fuel injector)
⑩ Fuse (20A)
(main switch and power trim and tilt switch)
⑪ Fuse (20 A)
(Rectifier Regulator)
⑫ Fuse (30 A)
(starter relay)

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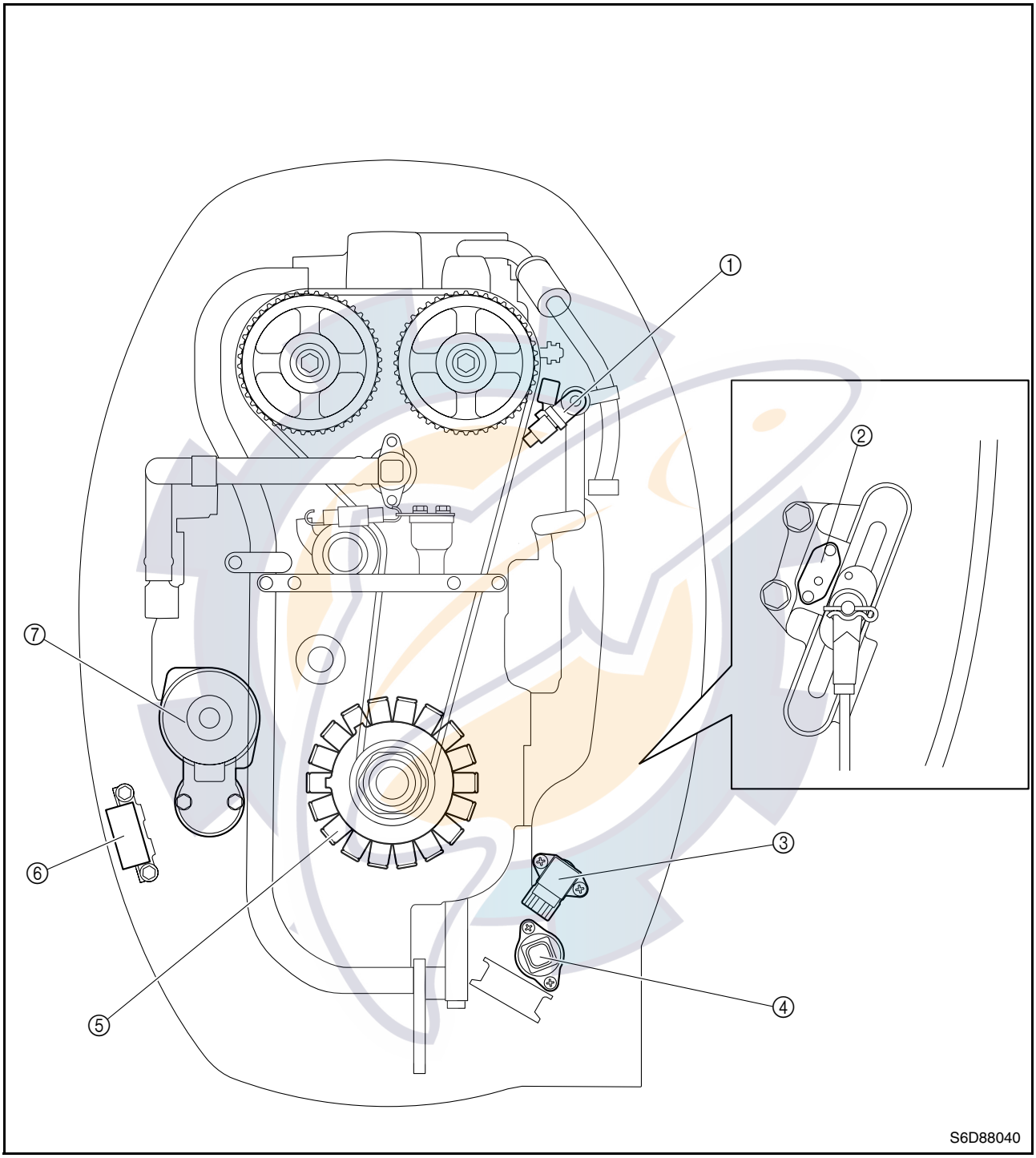
Top view



① Fuel injection
② Shift position switch
③ Sensor assembly
(intake air temperature and intake air pressure)
④ Idle speed control
⑤ Stator coil
⑥ Power trim and tilt switch
⑦ Starter motor

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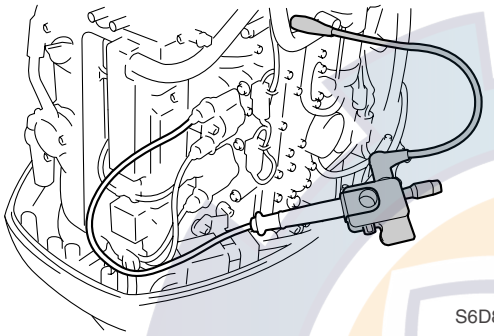
Ignition and ignition control system

Checking the ignition spark

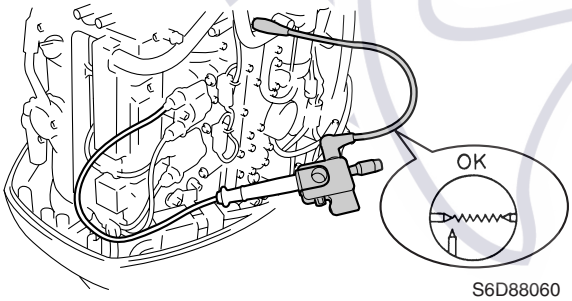
1. Remove the spark plug wire cover.
2. Disconnect the spark plug caps from the spark plugs.
3. Connect a spark plug cap to the special service tool.



S6D88050

Spark checker: YM-34487

4. Crank the engine and observe the spark through the discharge window of the special service tool. Check the ignition system if the spark is weak.



S6D88060

⚠ WARNING

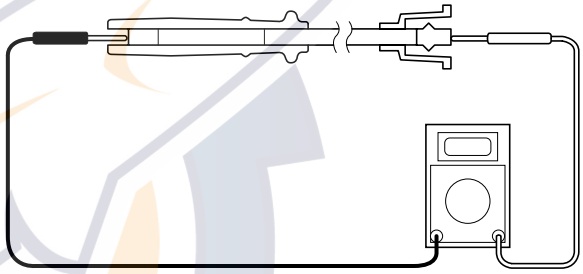
- **Do not touch any of the connections of the spark checker leads.**
- **Do not let sparks leak out of the removed spark plug caps.**
- **Keep flammable gas or liquids away, since this test can produce sparks.**

NOTE:

The ignition spark can also be checked using the “Stationary test” of the Yamaha Diagnostic System.

Checking the spark plug wires

1. Remove the spark plug wires from the spark plugs.
2. Remove the spark plug wires from the ignition coils.
3. Measure the spark plug wire resistance. Replace if out of specification.

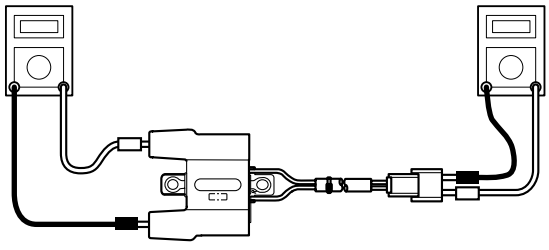


S60C8100

Spark plug wire resistance:
#1: 4.5–10.7 kΩ
#2: 3.3–8.0 kΩ
#3: 3.7–8.9 kΩ
#4: 4.3–10.2 kΩ

Checking the ignition coils

1. Remove the spark plug wires from the ignition coils.
2. Disconnect the ignition coil coupler.
3. Measure the ignition coil resistance. Replace if out of specification.



S63P8100

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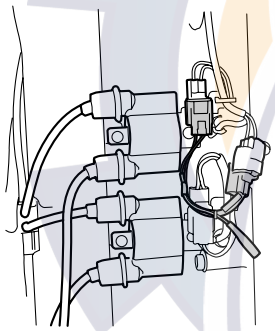
Ignition coil resistance:
Primary coil:
Red (R) – Black/white (B)
1.53–2.07 Ω at 20 °C (68 °F)
Secondary coil:
12.495–16.905 kΩ at
20 °C (68 °F)

Checking the ECM

1. Disconnect an ignition coil coupler.
2. Connect the test harness (2 pins) to the ignition coil.
3. Measure the ECM output peak voltage. If below specification, measure the pulser coil output peak voltage. Replace the ECM if the output peak voltage of the pulser coil is above specification.



S6D88070

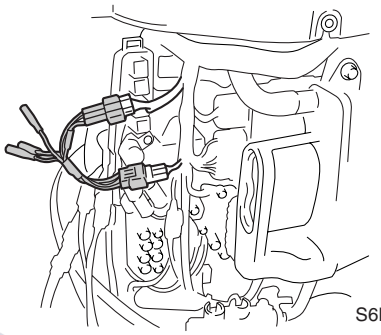
Digital multimeter: YU-34899-A
Peak volt meter adapter: YU-39991
Test harness (2 pins): YB-06792

ECM output peak voltage:
Black/red (B/R) – Ground
Black/white (B/W) – Ground

r/min	Loaded		
	Cranking	1,500	3,500
DC V	210	290	290

Checking the pulser coils

1. Remove the junction box cover. Disconnect the pulser coil coupler.
2. Connect the test harness (3 pins) to the pulser coil.
3. Measure the pulser coil output peak voltage. Replace the stator assembly if below specification.



S6D88080

NOTE:
Do not loosen the pulser coil screw.

Digital multimeter: YU-34899-A
Peak volt meter adapter: YU-39991
Test harness (3 pins): YB-06791

Pulser coil output peak voltage:
White/red (W/R) – Black (B)
White/black (W/B) – Black (B)

r/min	Unloaded	Loaded		
	Cranking		1,500	3,500
DC V	3.6	3.4	18.2	34.3

Pulser coil resistance
(reference data):
459–561 Ω

Checking the sensor assembly

1. Measure the ambient temperature.

8

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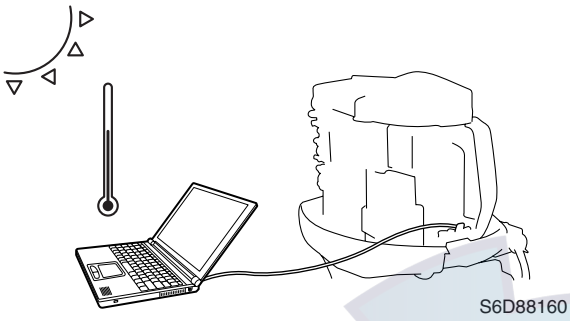
2. Connect a computer to the outboard motor and use the Yamaha Diagnostic System to display the intake air temperature.



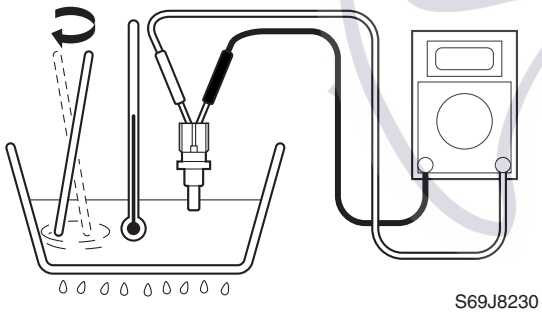
S6D88160

3. If the ambient temperature and the displayed intake air temperature differ by more than ± 5 °C (± 9 °F), replace the sensor assembly.

NOTE:
Check the sensor assembly when the engine is cold.

Checking the cooling water temperature sensor

1. Place the cooling water temperature sensor in a container of water and slowly heat the water.



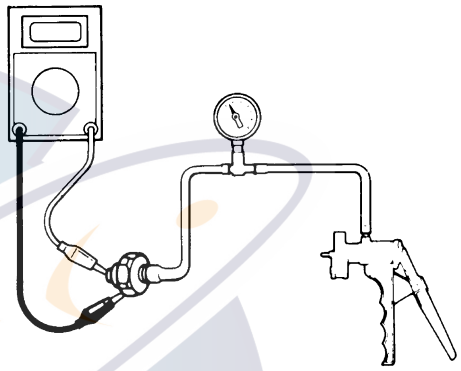
S69J8230

2. Measure the cooling water temperature sensor resistance. Replace if out of specification.

Cooling water temperature sensor resistance:
at 0 °C (32 °F): 5.21–6.37 kΩ
at 80 °C (176 °F): 0.290–0.354 kΩ

Checking the oil pressure switch

1. Check the oil pressure switch for continuity. Replace if there is no continuity.
2. Connect the special service tool to the oil pressure switch.
3. Slowly operate the special service tool.



S60C8180

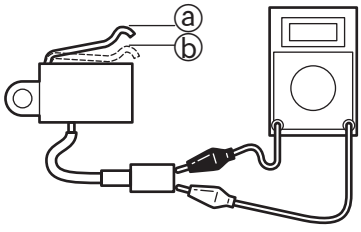
4. Check the oil pressure switch for no continuity at the specified pressure. Replace if there is continuity.

Pressure/vacuum tester:
YB-35956-A

Operating pressure:
127.5–166.7 kPa
(1.28–1.67 kgf/cm^2,
18.49–24.17 psi)

Checking the shift position switch

1. Check the shift position switch for continuity. Replace if there is no continuity.



S69J8270

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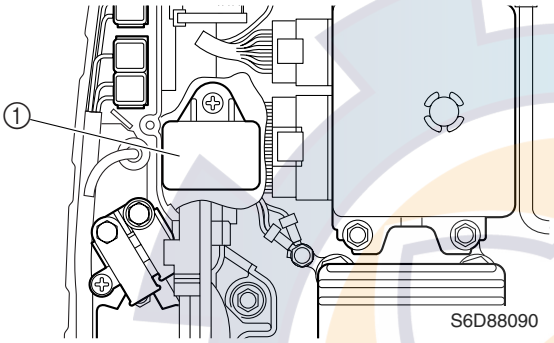
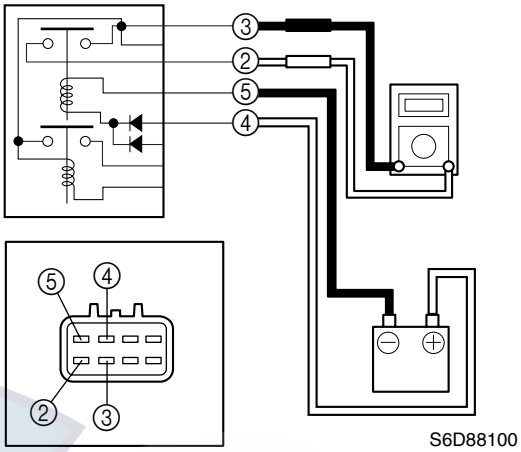
Switch position	Lead color	
	Blue/green (L/G)	Black (B)
Free ⓐ		
Push ⓑ	○	○

Checking the main and fuel pump relay (main control)

1. Remove the main and fuel pump relay ①.



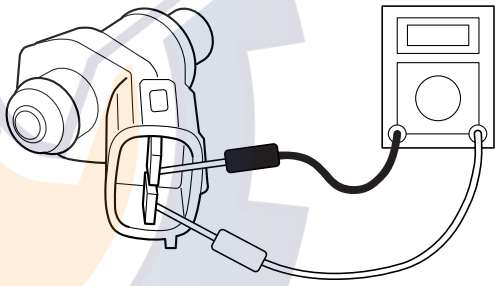
2. Connect the digital circuit tester leads to the relay terminals ② and ③.
3. Connect the positive battery terminal to the relay terminal ④.
4. Connect the negative battery terminal to the relay terminal ⑤.
5. Check for continuity between the relay terminals ② and ③. Replace if there is no continuity.
6. Check that there is no continuity between the relay terminals ② and ③ after disconnecting a battery terminal from the relay terminal ④ or ⑤. Replace if there is continuity.



Fuel control system

Checking the injectors

1. Measure the resistance of the fuel injectors.



Digital multimeter: YU-34899-A

Fuel injector resistance (reference data):
12.0 Ω at 21 °C (70 °F)

NOTE:
Check the operation of the fuel injectors using the “Stationary test” of the Yamaha Diagnostic System.

Checking the electric fuel pump

1. Turn the engine start switch to ON.

8

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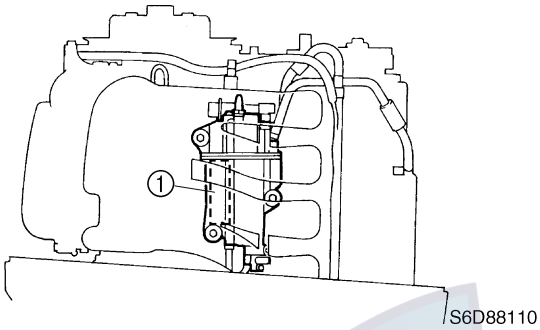
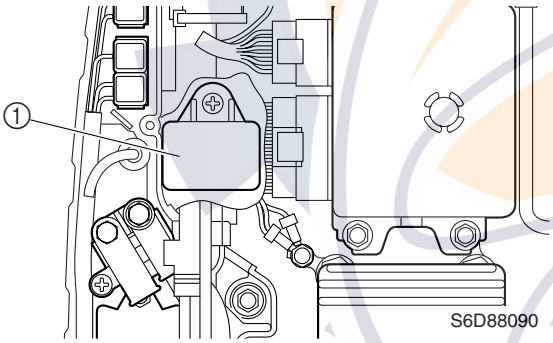
2. Listen for the operating sound of the electric fuel pump ①. Check the fuel system if there is no sound.



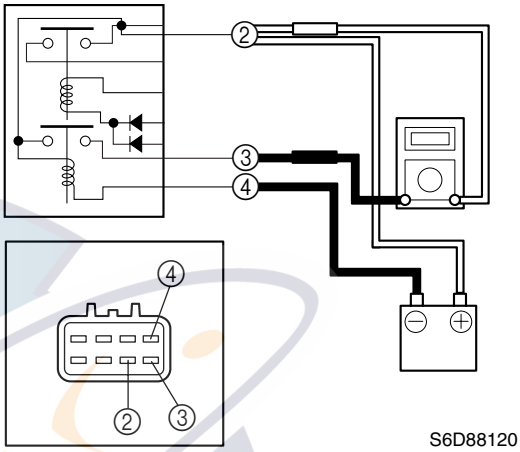
NOTE:
After the engine start switch is turned to ON, the electric fuel pump will operate for 3 seconds.

Checking the main and fuel pump relay (fuel control)

1. Remove the main and fuel pump relay ①.



2. Connect the digital circuit tester leads to the relay terminals ② and ③.
3. Connect the positive battery terminal to the relay terminal ②.
4. Connect the negative battery terminal to the relay terminal ④.
5. Check for continuity between the relay terminals ② and ③. Replace if there is no continuity.
6. Check that there is no continuity between the relay terminals ② and ③ after disconnecting a battery terminal from the relay terminal ② or ④. Replace if there is continuity.



Starting system

Checking the fuses

1. Check the fuses for continuity. Replace if there is no continuity.

Checking the starter relay

1. Connect the digital circuit tester leads to the starter relay terminals.
2. Connect the positive battery terminal to the brown (Br) lead.
3. Connect the negative battery terminal to the black (B) lead.
4. Check for continuity between the starter relay terminals. Replace if there is no continuity.
5. Check that there is no continuity between the starter relay terminals after disconnecting a battery terminal from the brown (Br) or black (B) lead. Replace if there is continuity.

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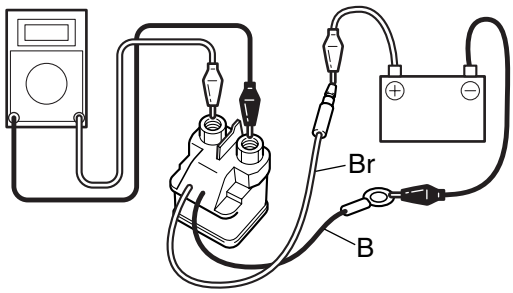

S60V8265

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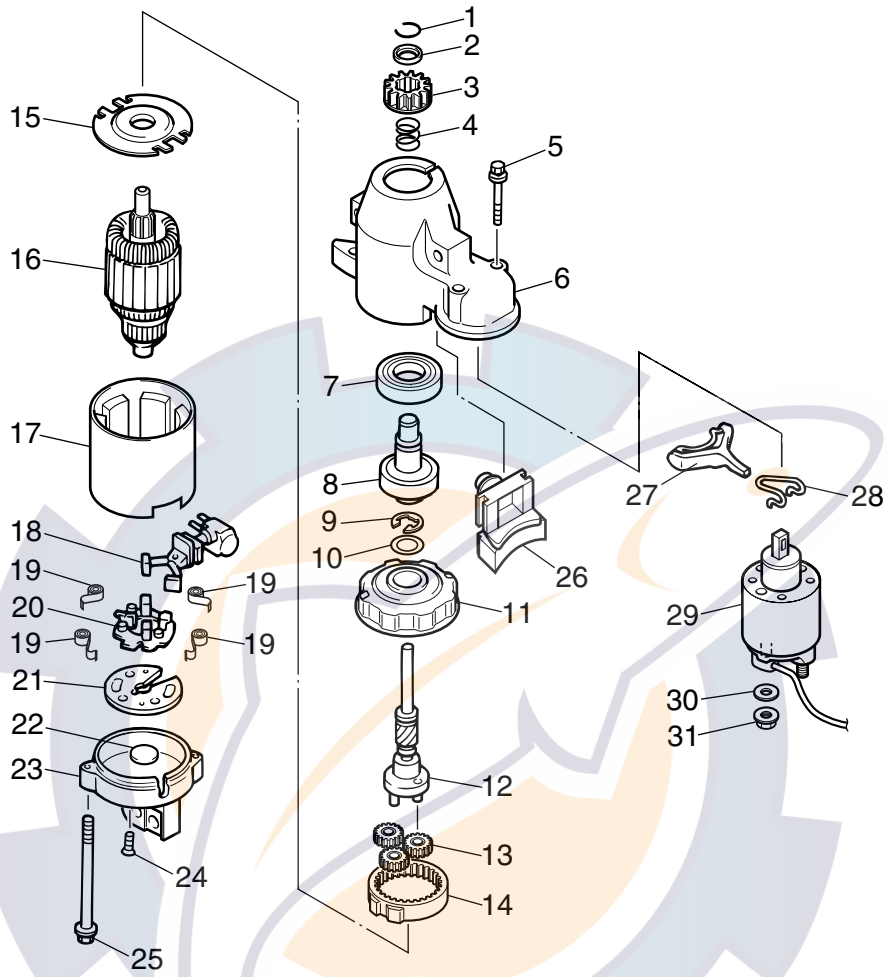
Starter motor



S63P8050

No.	Part name	Q'ty	Remarks
1	Clip	1	
2	Pinion stopper	1	
3	Starter motor pinion	1	
4	Spring	1	
5	Bolt	2	M6 × 35 mm
6	Housing	1	
7	Bearing	1	
8	Clutch assembly	1	
9	E-clip	1	**Not reusable**
10	Washer	1	
11	Bracket	1	
12	Pinion shaft	1	
13	Planetary gear	3	
14	Outer gear	1	
15	Plate	1	
16	Armature	1	
17	Stator	1	

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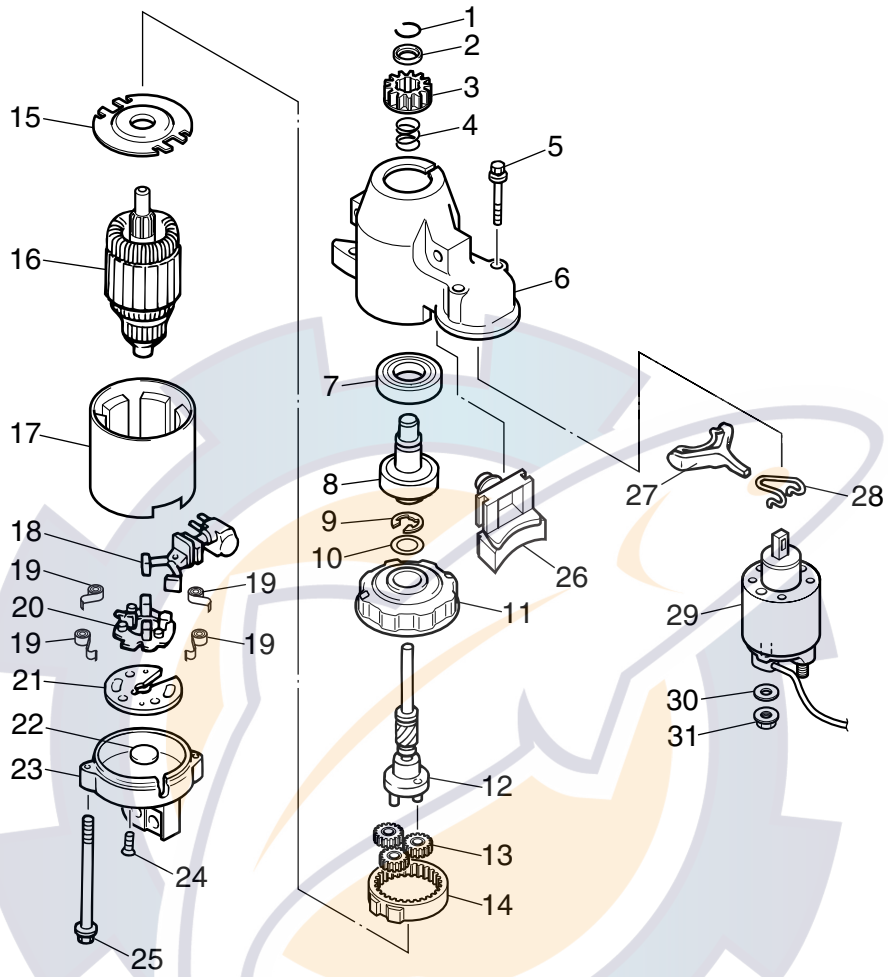

S63P8050

No.	Part name	Q'ty	Remarks
18	Brush assembly	1	
19	Brush spring	4	
20	Brush holder	1	
21	Plate	1	
22	Washer	1	
23	Bracket	1	
24	Screw	2	ø4 × 15 mm
25	Bolt	2	M6 × 120 mm
26	Rubber seal	1	
27	Shift lever	1	
28	Spring	1	
29	Magnet switch assembly	1	
30	Washer	1	
31	Nut	1	

8

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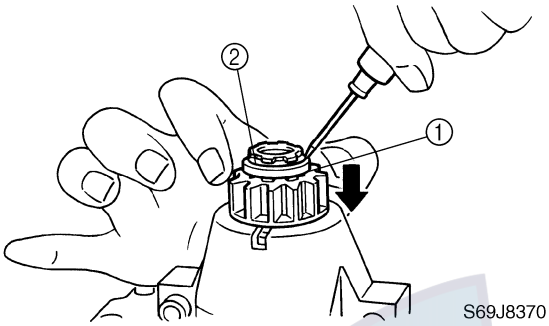
Disassembling the starter motor

1. Slide the pinion stopper ① down as shown, and then remove the clip ②.



S69J8370

NOTE:
Remove the clip with a thin screwdriver.

2. Remove the bolts, and then disassemble the starter motor.

Checking the starter motor pinion

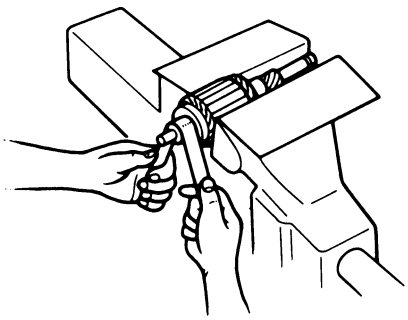
1. Check the teeth of the pinion for cracks or wear. Replace if necessary.

2. Check for smooth operation. Replace if necessary.

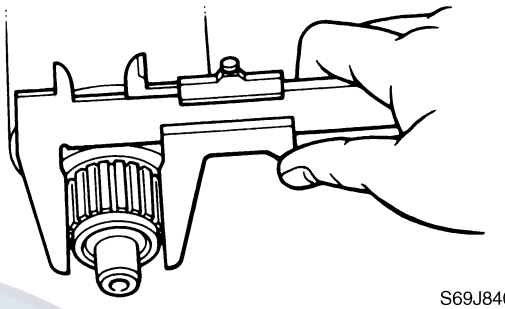
NOTE:
Turn the pinion counterclockwise to check that it operates smoothly and turn it clockwise to check that it locks in place.

Checking the armature

1. Check the commutator for dirt. Clean with 600–grit sandpaper and compressed air if necessary.

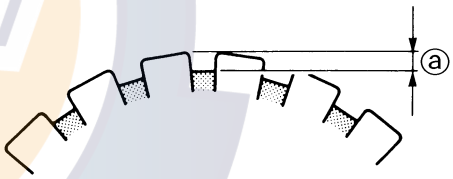

S69J8390

2. Measure the commutator diameter. Replace the armature if below specification.


S69J8400

Commutator diameter wear limit:
28.0 mm (1.10 in)

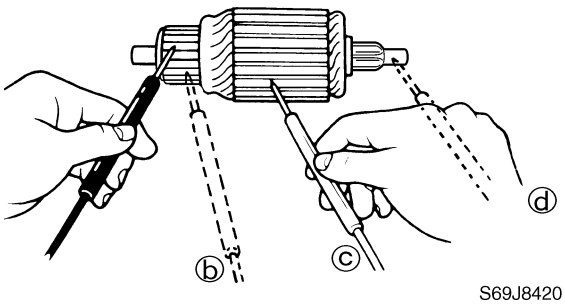
3. Measure the commutator undercut ⓐ. Replace the armature if below specification.



S69J8410

Commutator undercut wear limit ⓐ:
0.2 mm (0.01 in)

4. Check the armature for continuity. Replace if out of specifications.



S69J8420

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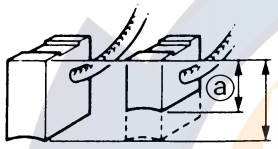
Armature continuity	
Commutator segments ⓑ	Continuity
Segment – Armature core ⓒ	No continuity
Segment – Armature shaft ⓓ	No continuity

Checking the brushes

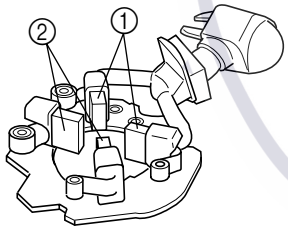
1. Measure the brush length. Replace the brush assembly if below specification.



S69J8430

Brush length wear limit ⓐ: 9.5 mm (0.37 in)

2. Check the brush holder assembly for continuity. Replace if out of specification.

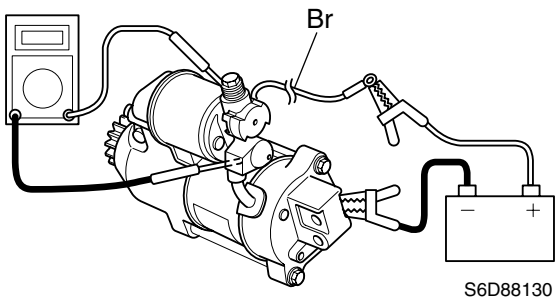


S69J8440

Brush continuity	
Brush ① – Brush ②	No continuity

Checking the magnet switch

1. Connect the tester leads between the magnet switch terminals as shown.
2. Connect the positive battery lead to the brown (Br) lead.
3. Connect the negative battery lead to the starter motor body.



S6D88130

CAUTION:

Do not connect the battery for more than one second, otherwise the magnet switch can be damaged.

4. Check that there is continuity between the magnet switch terminals. Replace if there is no continuity.
5. Check that there is no continuity after the negative battery terminal is removed. Replace if there is continuity.

NOTE:

The starter motor pinion should be pushed out while the magnet switch is on.

Checking the starter motor operation

1. Check the operation of the starter motor after installing it onto the power unit.

Charging system

Checking the stator coil

1. Disconnect the stator coil coupler.
2. Connect the test harness (6 pins) to the stator coil coupler.

8

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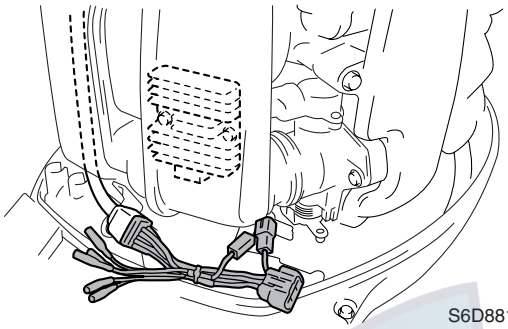
3. Measure the stator coil output peak voltage. Replace the stator coil if below specification.


S6D88140

Digital multimeter: YU-34899-A
Peak volt meter adapter: YU-39991
Test harness (6 pins): YB-06848

Stator coil output peak voltage:
White (W) – White (W)

r/min	Unloaded		
	Cranking	1,500	3,500
DC V	12.4	45.3	98.3

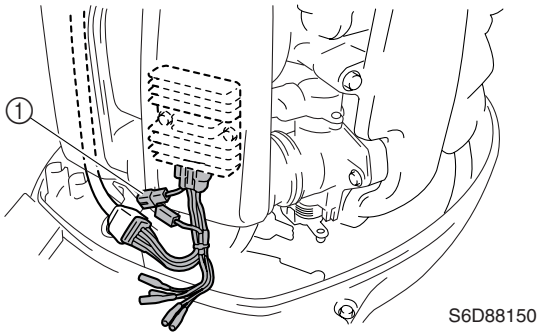
Stator coil resistance
(reference data):
White (W) – White (W)
0.24–0.36 Ω at 20 °C (68 °F)

Checking the Rectifier Regulator

1. Disconnect the stator coil coupler.

2. Connect the test harness (6 pins) between the Rectifier Regulator and stator coil coupler.

3. Disconnect the test harness coupler and then measure the Rectifier Regulator output peak voltage at the coupler ①. If below specification, measure the stator coil output peak voltage. Replace the Rectifier Regulator if the output peak voltage of the stator coil is above specification.



S6D88150

Digital multimeter: YU-34899-A
Test harness (6 pins): YB-06848

Rectifier Regulator output peak voltage:
Red (R) – Ground

r/min	Unloaded	
	1,500	3,500
DC V	13.0	13.0

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Troubleshooting

Special service tools **9-1**

Yamaha Diagnostic System **9-2**
Introduction 9-2

Power unit **9-5**

Bracket unit **9-13**

Electrical systems **9-17**

Self-diagnosis **9-18**
Diagnosing the electronic control system 9-18

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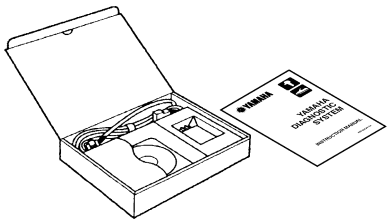
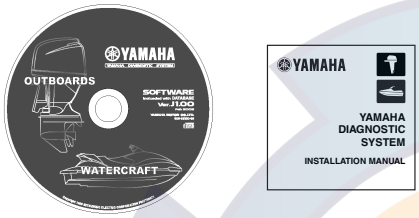
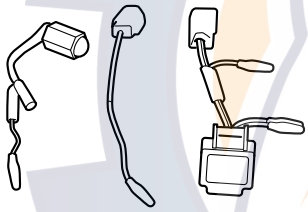
Special service tools



Yamaha Diagnostic System
60V-85300-02



Yamaha Diagnostic System
60V-WS853-02



Diagnostic test lead
YB-06795

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Yamaha Diagnostic System

Introduction

Features

The newly developed Yamaha Diagnostic System provides quicker detection and analysis of engine malfunctions for quicker troubleshooting procedures than traditional methods.
By connecting your computer to the ECM (Electronic Control Module) of an outboard motor using the communication cable, this software can be used to display sensor data and data stored in the ECM on a computer's monitor.
If this software is run on Microsoft Windows® 95, Windows 98, Windows Me, Windows 2000, or Windows XP the information can be displayed in colorful graphics. Also, the software can be operated using either a mouse or a keyboard.
In addition, the data for the main functions (Diagnosis, Diagnosis record, Engine monitor, and Data logger) can be saved on a disk or printed out.

Functions

1. **Diagnosis:** With the engine main switch ON, each sensor's status and each ECM diagnosis code or item is displayed. This enables you to find malfunctioning parts and controls quickly.

2. **Diagnosis record:** Sensors that had been activated and ECM diagnostic codes that have been recorded are displayed. This allows you to check the outboard motor's record of malfunctions.

3. **Engine monitor:** Each sensor status and the ECM data are displayed while the engine is running. This enables you to find malfunctioning parts quickly.

4. **Stationary test:** With the engine off, the ignition, fuel injection, electric fuel pump, and ISC valve are checked. These tests can be performed quickly.

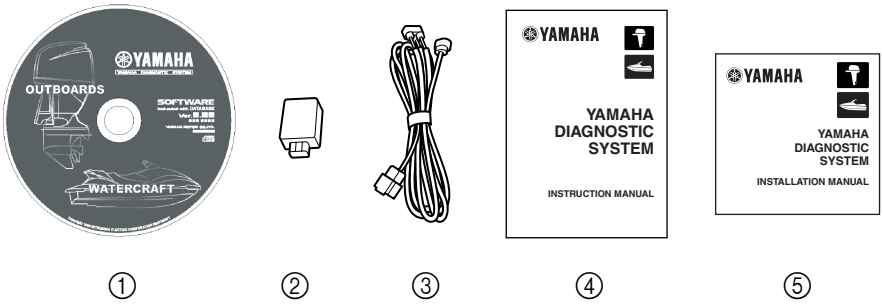
5. **Active test:** With the engine running, each firing cylinder has dropped and the engine speed is checked for changes to determine whether the cylinder is malfunctioning and the ISC valve is checked as well. These tests can be performed quickly.

6. **Data logger:** Displays 13 minutes of recorded data for two or more of the items stored in the ECM. In addition, the operating time as compared to the engine speed and the total operating time are displayed. This allows you to check the operating status of the engine.

7. **Some files:** Lets you select and run other applications while continuing to run the diagnostic program.

Contents

1. Software (1)
2. Adapter (1)
3. Communication cable (1)
4. Instruction Manual (1)
5. Installation Manual (1)



① ② ③ ④ ⑤

9

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Hardware requirements

Make sure that your computer meets the following requirements before using this software.

Computer:	IBM-compatible computer
Operating system:	Microsoft (Windows 95,) Windows 98, Windows Me, Windows 2000, or Windows XP (English version)
CPU:	
Windows 95/98:	i486X, 100 MHz or higher (Pentium 100 MHz or higher recommended)
Windows Me/2000:	Pentium, 166 MHz or higher (Pentium 233 MHz or higher recommended)
Windows XP:	Pentium, 300 MHz or higher (Pentium 500 MHz or higher recommended)
Memory:	
Windows 95/98:	16 MB or more (32 MB or more recommended)
Windows Me:	32 MB or more (64 MB or more recommended)
Windows 2000:	64 MB or more (128 MB or more recommended)
Windows XP:	128 MB or more (256 MB or more recommended)
Hard disk free space:	20 MB or more (40 MB or more recommended)
Drive:	CD-ROM drive
Display:	VGA (640 × 480 pixels), (SVGA [800 × 600 pixels] or more recommended) 256 or more colors
Mouse:	Compatible with the operating systems mentioned above
Communication port:	RS232C (Dsub-9 pin) port, USB port
Printer:	Compatible with the operating systems mentioned above

NOTE:

- The amount of memory and the amount of free space on the hard disk differs depending on the computer.
- Using this software while there is not enough free space on the hard disk could cause errors and result in insufficient memory.
- This software will not run properly on some computers.
- When starting up this program, do not start other software applications.
- Do not use the screen saver function or the energy saving feature when using this program.
- If the ECM is changed, restart the program.
- Windows XP is a multiuser operating system, therefore, be sure to end this program if the login user is changed.
- The USB adapter cannot be used with Windows 95.

For operating instructions of the Yamaha Diagnostic System, refer to the “Yamaha Diagnostic System Instruction Manual.”

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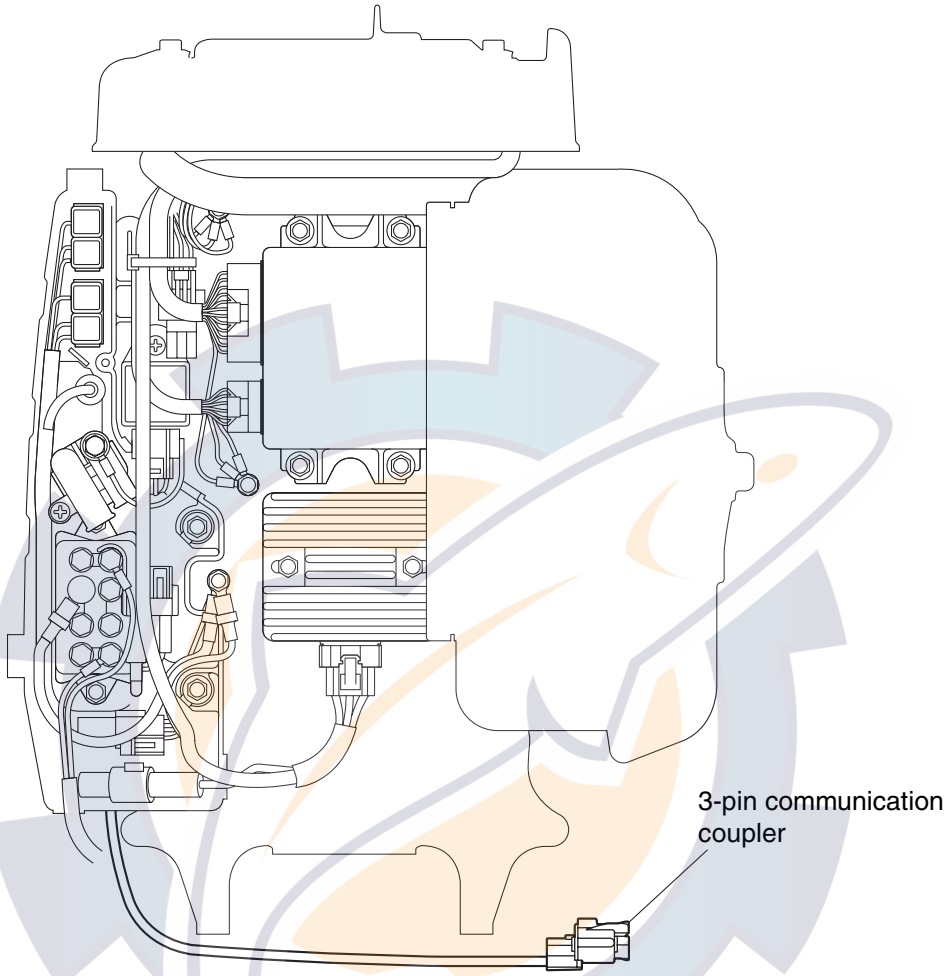
Connecting the communication cable to the outboard motor

Bow view



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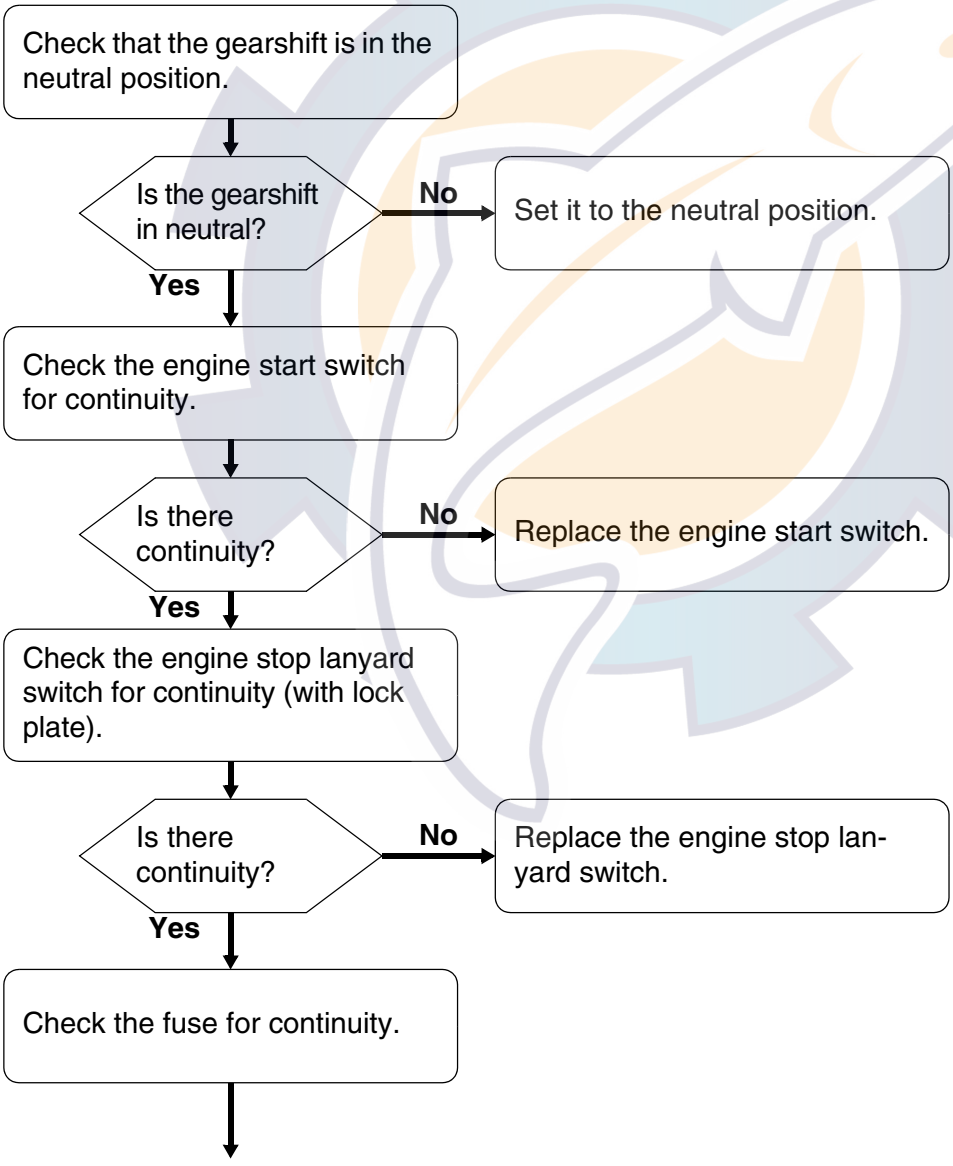
NOTE:
- Check that all electrical connections are tight and free from corrosion, and that the battery is fully charged to 12 V.
- To diagnose a mechanical malfunction, use the troubleshooting charts pertaining to the trouble located in this chapter. Also, when checking and maintaining the outboard motor, see Chapters 3–8 for safe maintenance procedures.
- To diagnose a malfunctioning sensor or switch, use the diagnostic test lead to determine the cause.

Power unit

Symptom: Engine does not crank.
- Check the starting system.
- Check the power unit.


Check that the gearshift is in the neutral position.
Is the gearshift in neutral?
No
Set it to the neutral position.
Yes
Check the engine start switch for continuity.
Is there continuity?
No
Replace the engine start switch.
Yes
Check the engine stop lanyard switch for continuity (with lock plate).
Is there continuity?
No
Replace the engine stop lanyard switch.
Yes
Check the fuse for continuity.

Continued on next page.

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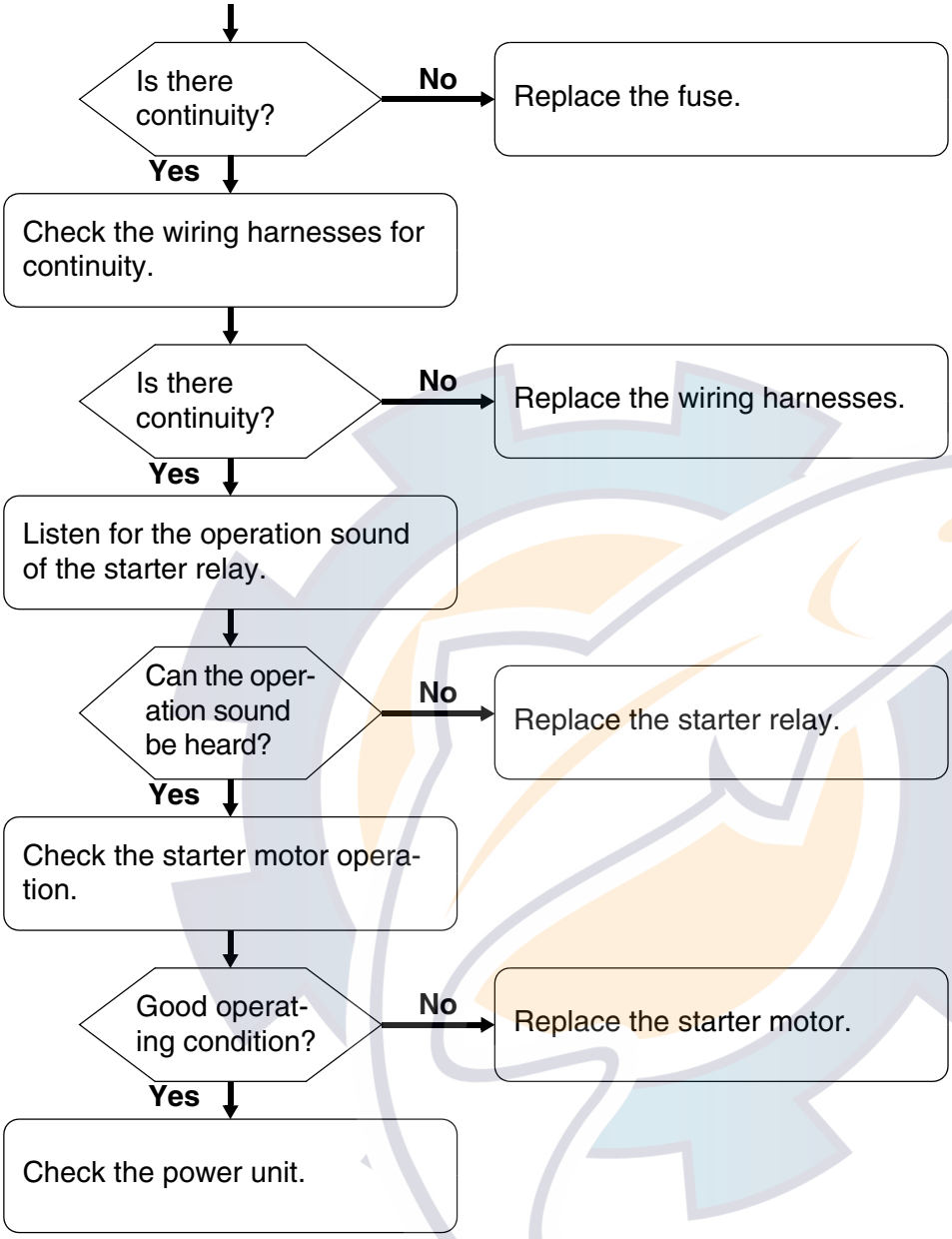

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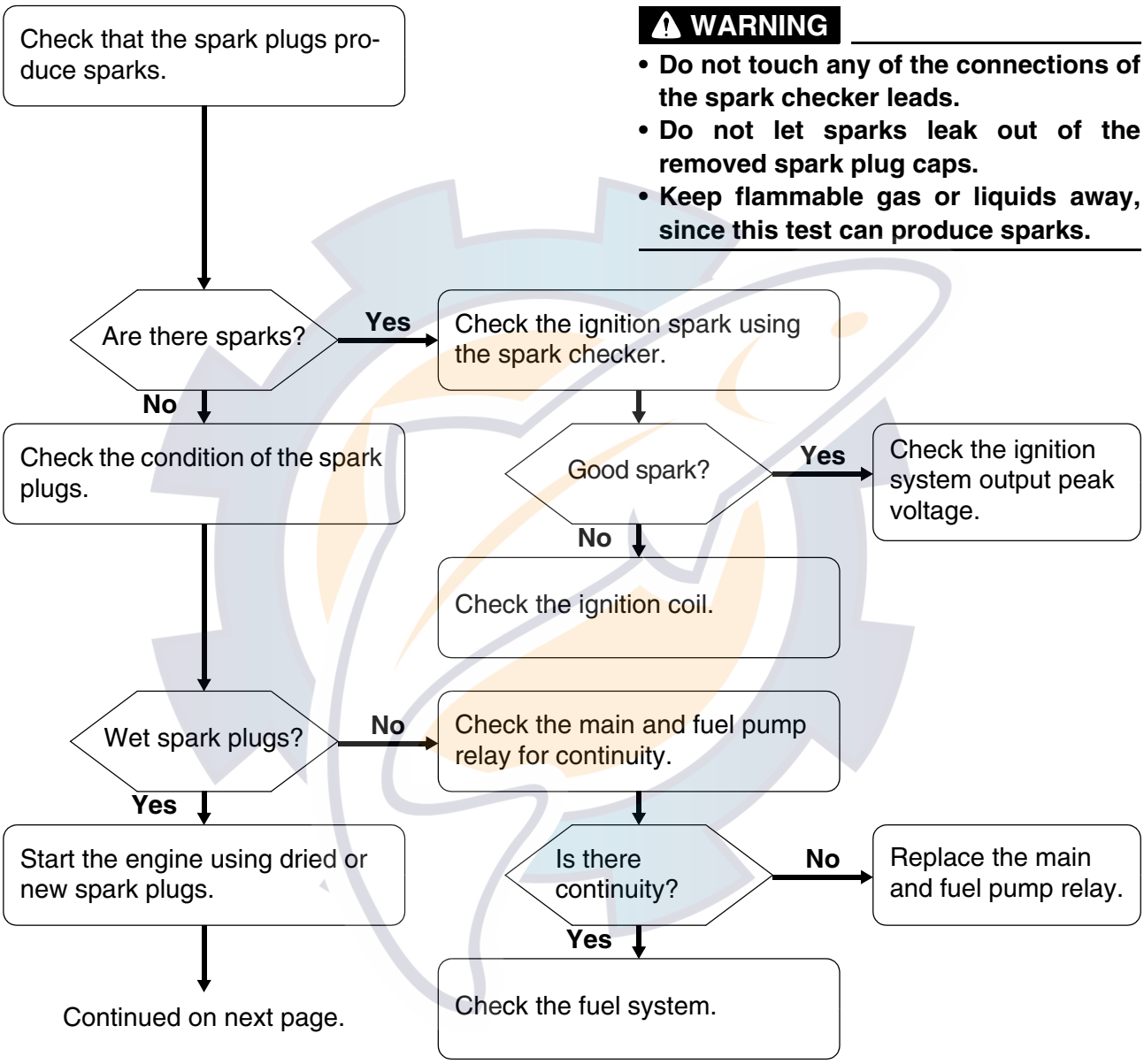
Symptom: Engine cranks, but will not start (engine stop lanyard switch is operating normally).

- Check the ignition system.
- Check the fuel system.
- Check the compression pressure of the power unit.

⚠ WARNING

- **Do not touch any of the connections of the spark checker leads.**
- **Do not let sparks leak out of the removed spark plug caps.**
- **Keep flammable gas or liquids away, since this test can produce sparks.**



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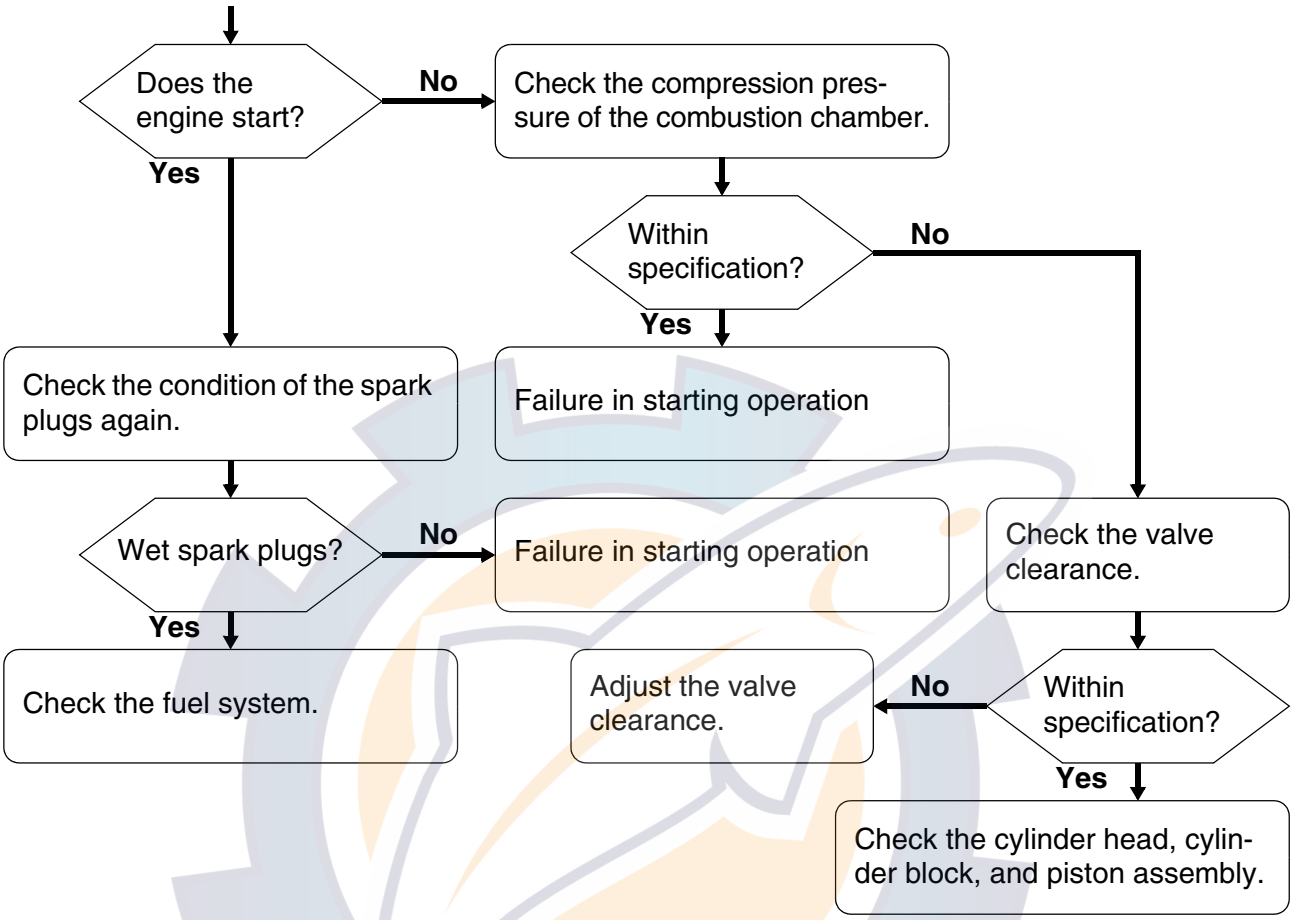

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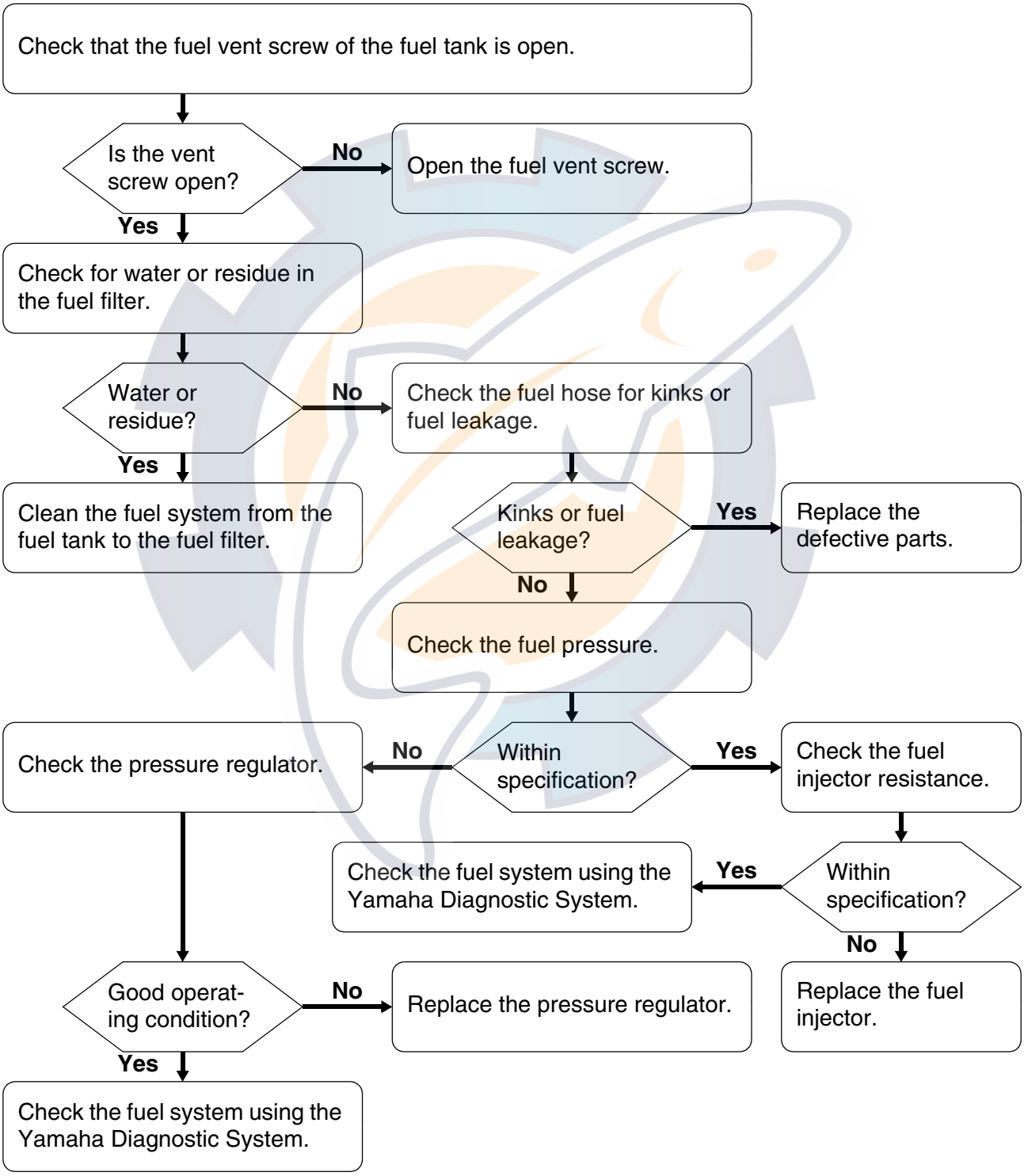
Symptom: Engine can be started, but does not remain on.

- Check the fuel system.
- Check the ignition system.
- Check the compression pressure of the power unit.

Fuel system



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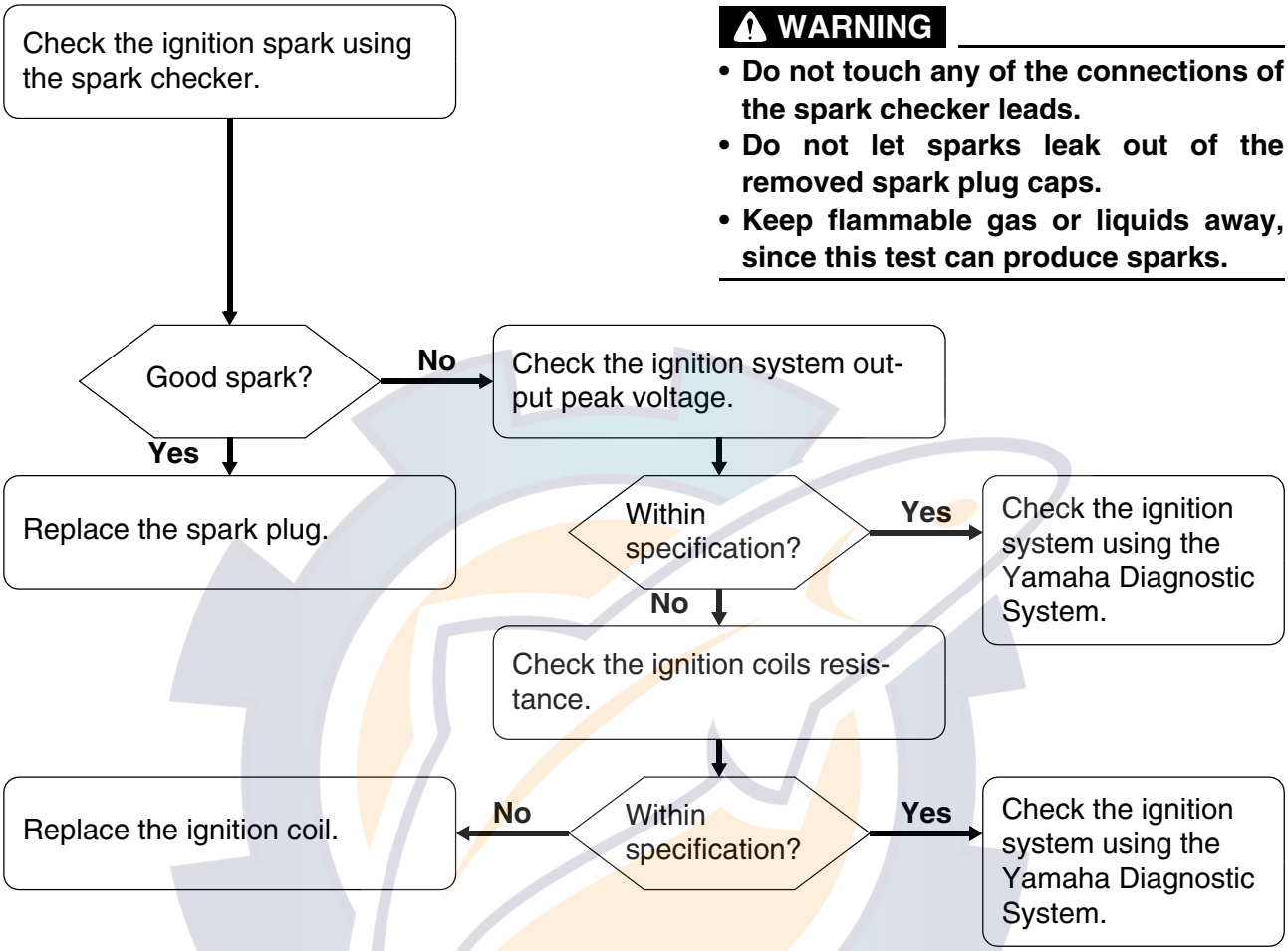
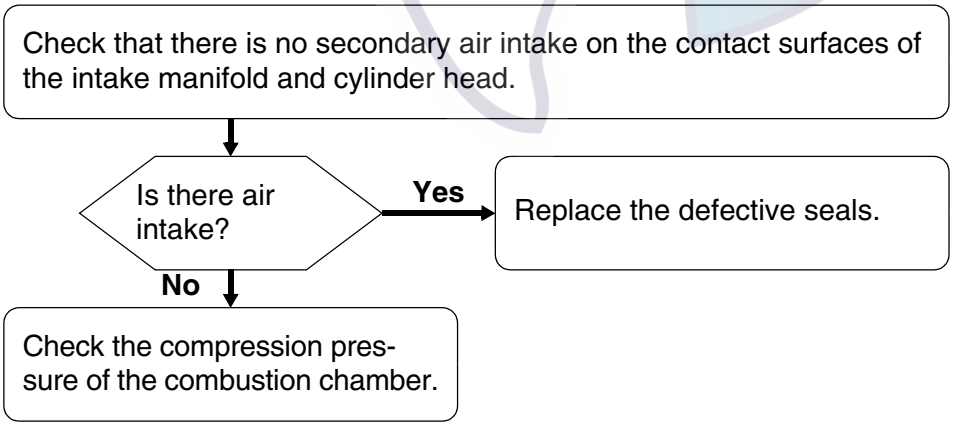
Ignition system



⚠ WARNING

- **Do not touch any of the connections of the spark checker leads.**
- **Do not let sparks leak out of the removed spark plug caps.**
- **Keep flammable gas or liquids away, since this test can produce sparks.**

Compression pressure


Check that there is no secondary air intake on the contact surfaces of the intake manifold and cylinder head.
Is there air intake?
Yes
Replace the defective seals.
No
Check the compression pressure of the combustion chamber.

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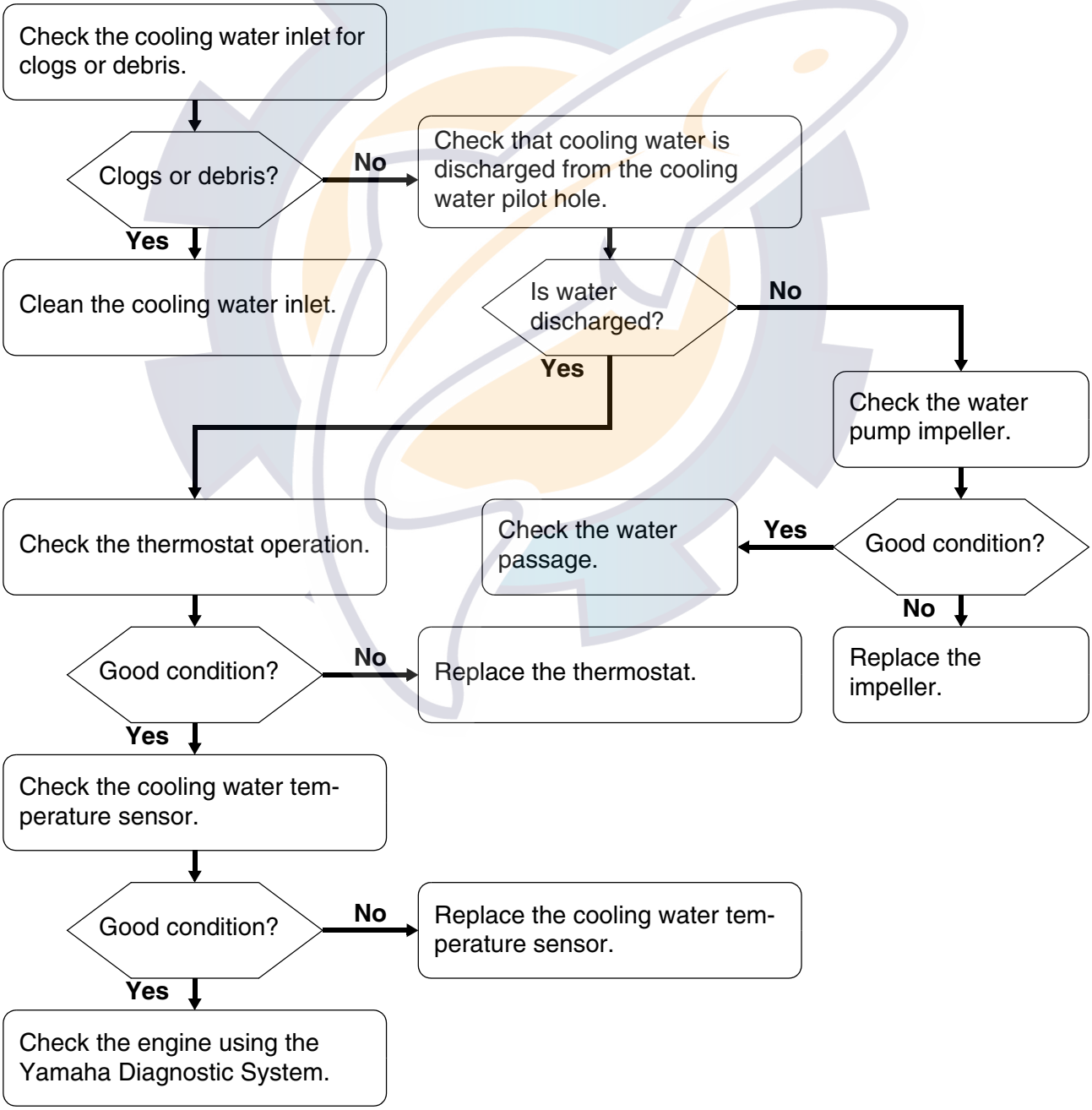
Symptom: Engine does not accelerate when the throttle is opened quickly.
The engine turns off when the throttle is opened quickly.
Acceleration is tardy and the engine is likely to stop at any moment.
• Check the engine using the diagnostic flash indicator or the Yamaha Diagnostic System.

Symptom: Engine can run, but engine speed will not increase.
Overheat warning indicator is on.
Oil pressure warning indicator is on.
Warning indicator is on and buzzer is sounding.
• Check the cooling system.
• Check the lubrication system.

Cooling system



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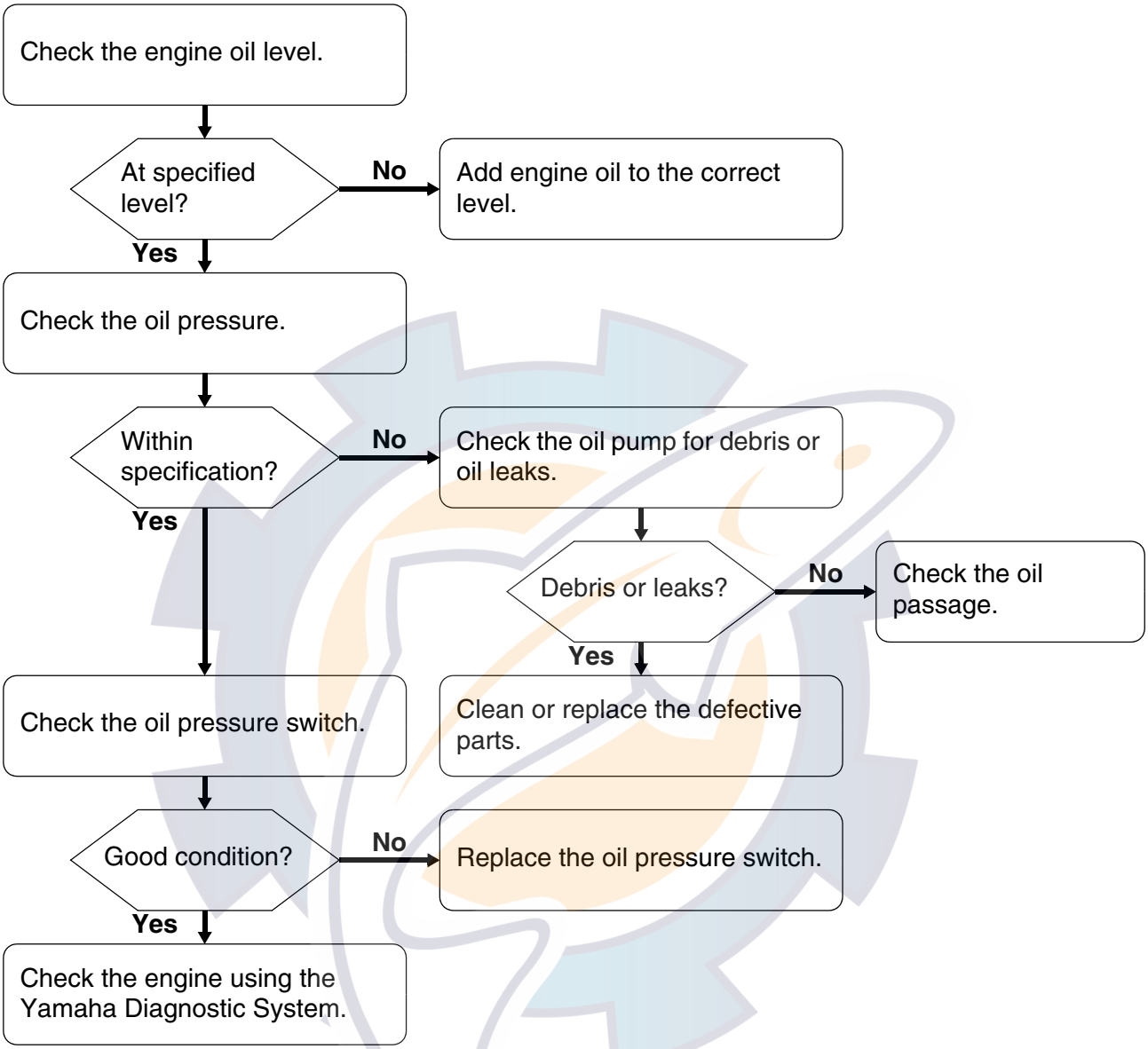
Lubrication system



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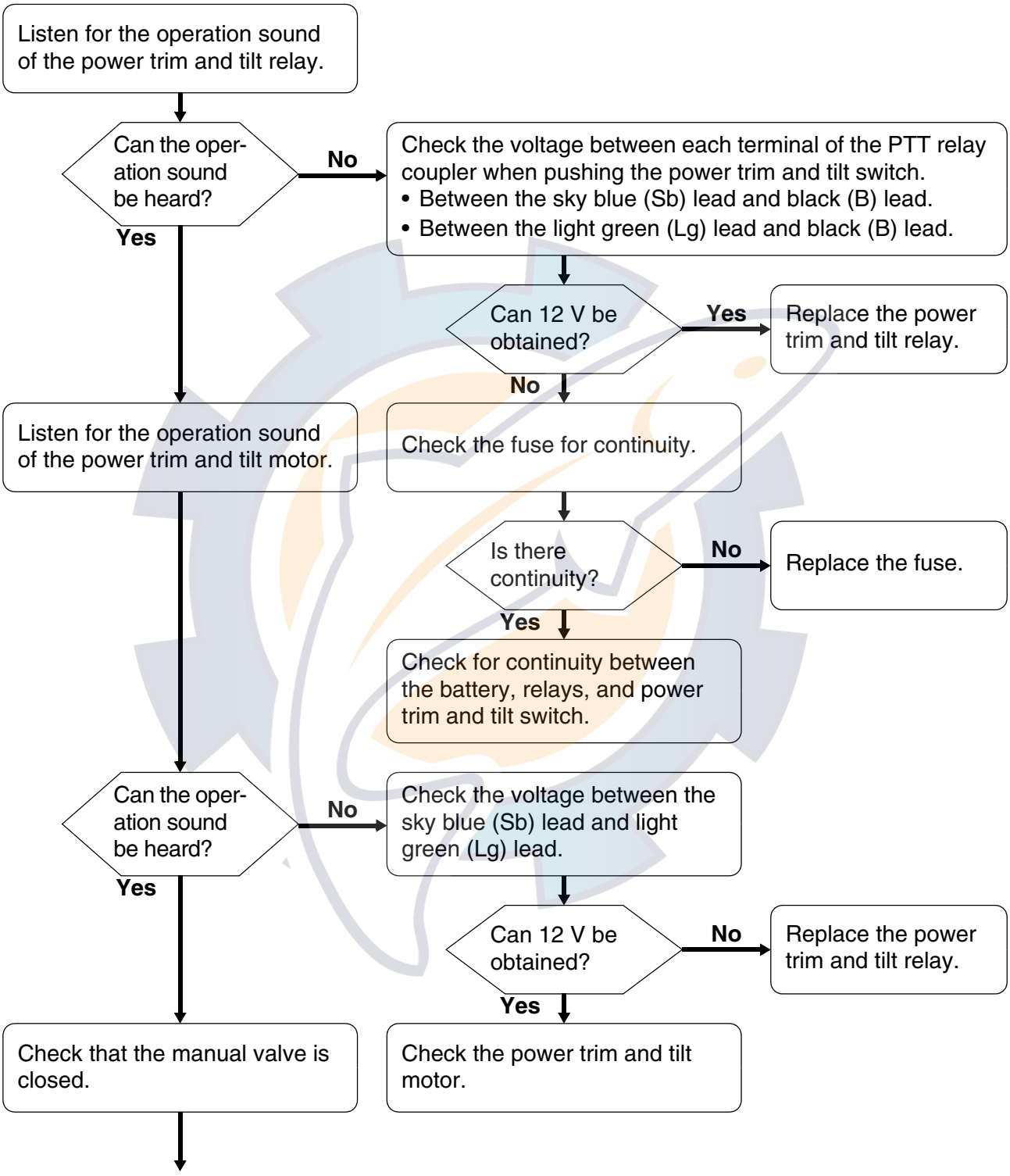
Bracket unit

Symptom: Power trim and tilt unit does not operate.


Listen for the operation sound of the power trim and tilt relay.
Can the operation sound be heard?
No
Yes
Check the voltage between each terminal of the PTT relay coupler when pushing the power trim and tilt switch.
• Between the sky blue (Sb) lead and black (B) lead.
• Between the light green (Lg) lead and black (B) lead.
Can 12 V be obtained?
Yes
Replace the power trim and tilt relay.
No
Listen for the operation sound of the power trim and tilt motor.
Check the fuse for continuity.
Is there continuity?
No
Replace the fuse.
Yes
Check for continuity between the battery, relays, and power trim and tilt switch.
Can the operation sound be heard?
No
Check the voltage between the sky blue (Sb) lead and light green (Lg) lead.
Yes
Can 12 V be obtained?
No
Replace the power trim and tilt relay.
Yes
Check that the manual valve is closed.
Check the power trim and tilt motor.

Continued on next page.

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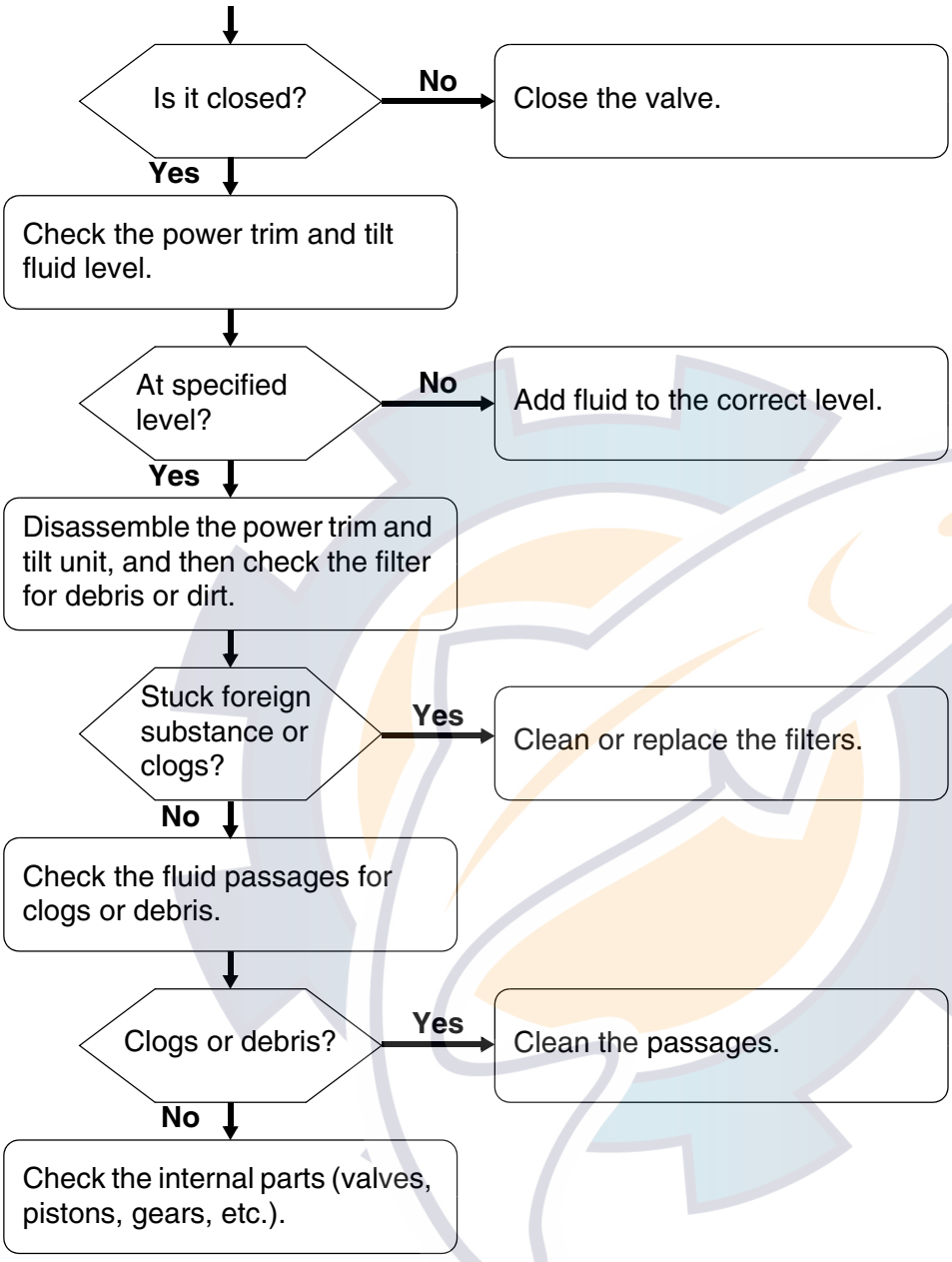
Is it closed?
No
Close the valve.
Yes
Check the power trim and tilt fluid level.
At specified level?
No
Add fluid to the correct level.
Yes
Disassemble the power trim and tilt unit, and then check the filter for debris or dirt.
Stuck foreign substance or clogs?
Yes
Clean or replace the filters.
No
Check the fluid passages for clogs or debris.
Clogs or debris?
Yes
Clean the passages.
No
Check the internal parts (valves, pistons, gears, etc.).

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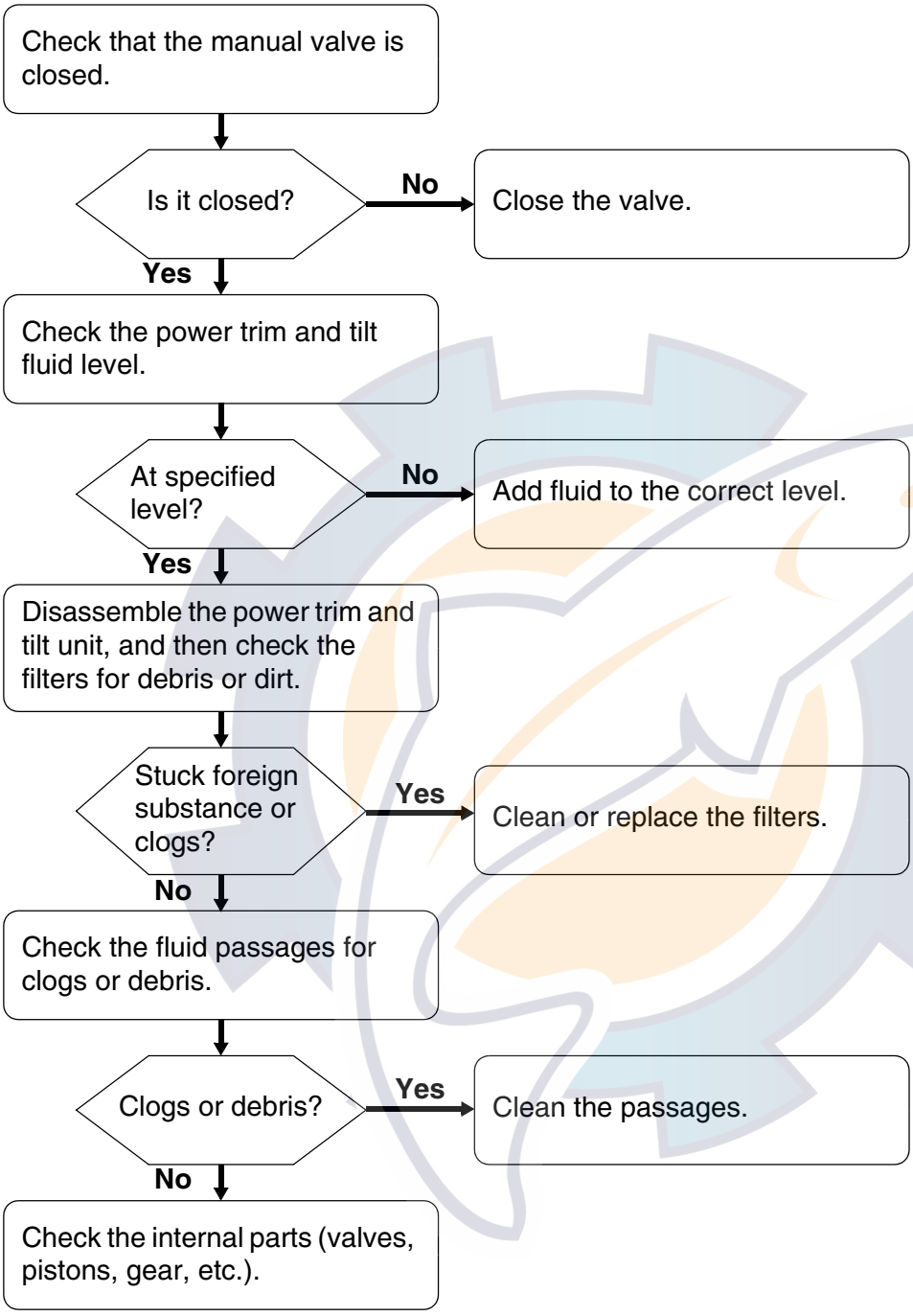
Symptom: Power trim and tilt unit does not hold the outboard motor up.


Check that the manual valve is closed.
Is it closed?
No
Close the valve.
Yes
Check the power trim and tilt fluid level.
At specified level?
No
Add fluid to the correct level.
Yes
Disassemble the power trim and tilt unit, and then check the filters for debris or dirt.
Stuck foreign substance or clogs?
Yes
Clean or replace the filters.
No
Check the fluid passages for clogs or debris.
Clogs or debris?
Yes
Clean the passages.
No
Check the internal parts (valves, pistons, gear, etc.).

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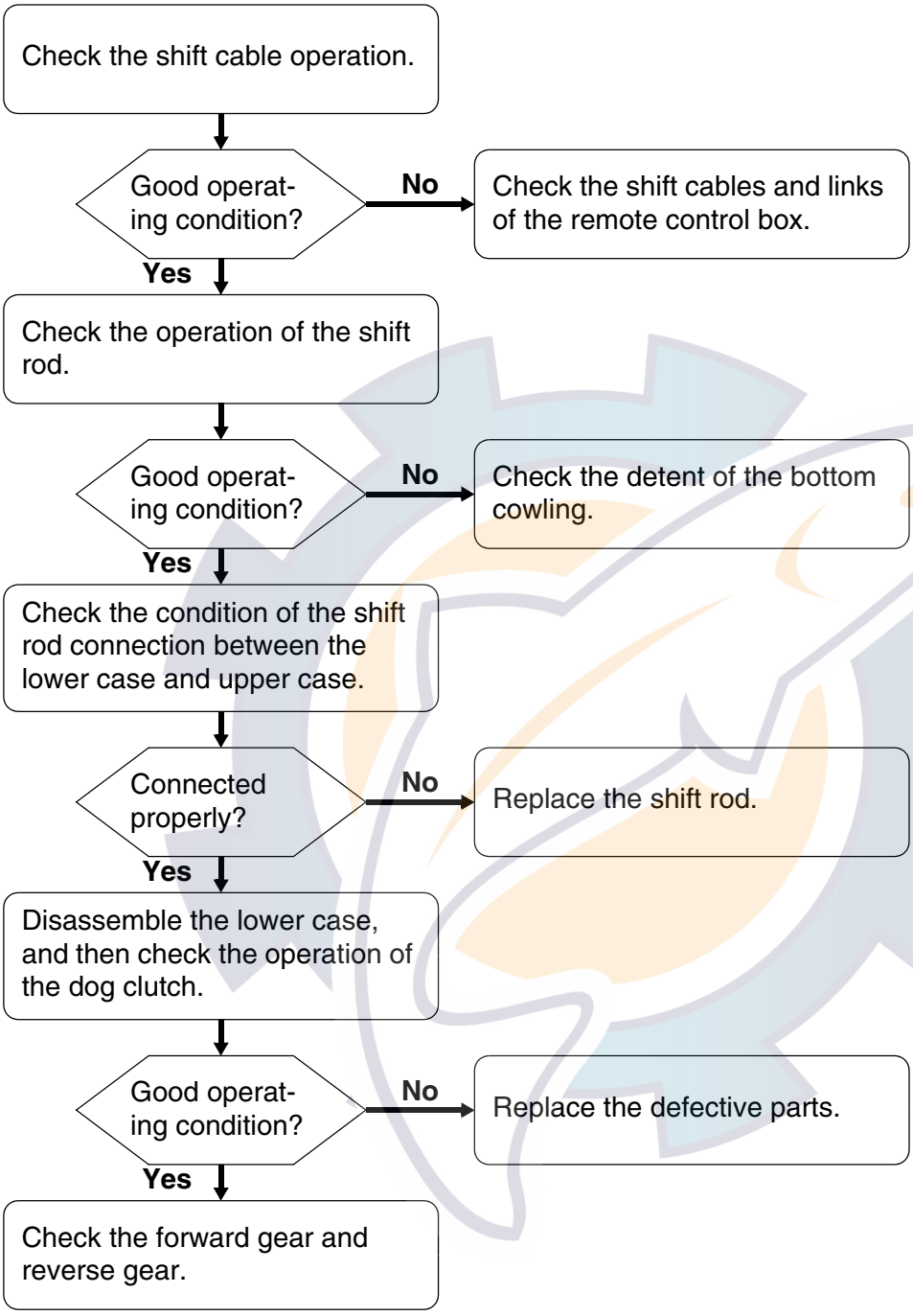
Symptom: Shift mechanism of the forward gear and reverse gear does not operate properly.


Check the shift cable operation.
Good operating condition?
No
Check the shift cables and links of the remote control box.
Yes
Check the operation of the shift rod.
Good operating condition?
No
Check the detent of the bottom cowling.
Yes
Check the condition of the shift rod connection between the lower case and upper case.
Connected properly?
No
Replace the shift rod.
Yes
Disassemble the lower case, and then check the operation of the dog clutch.
Good operating condition?
No
Replace the defective parts.
Yes
Check the forward gear and reverse gear.

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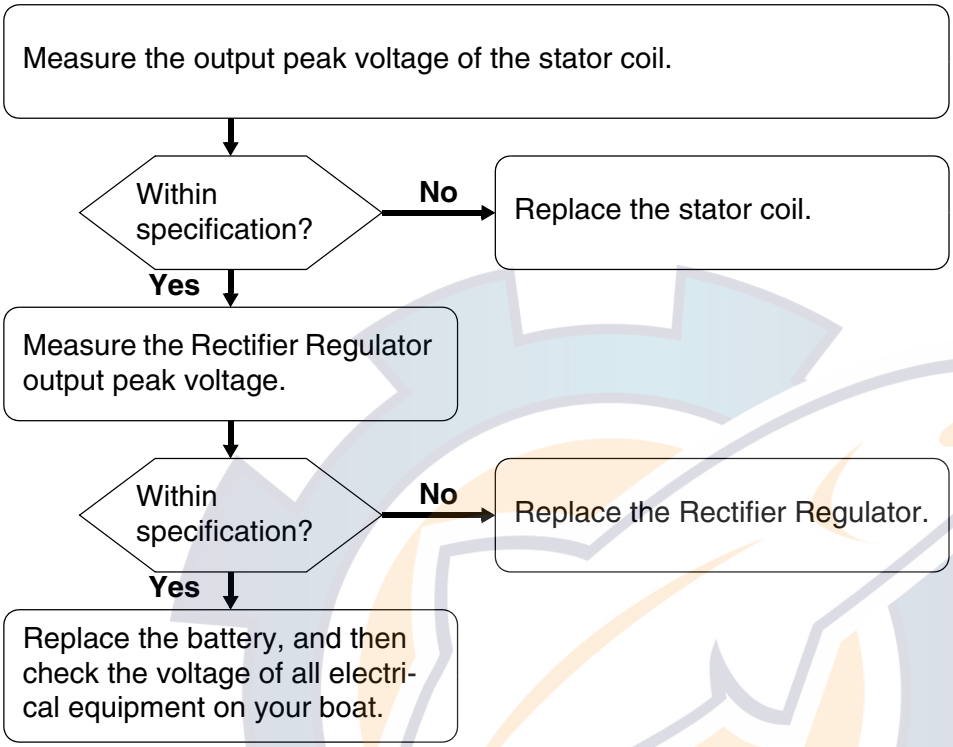
Electrical systems

Symptom: Battery becomes weaker quickly.

• Check the charging system.


Measure the output peak voltage of the stator coil.
Within specification?
No
Replace the stator coil.
Yes
Measure the Rectifier Regulator output peak voltage.
Within specification?
No
Replace the Rectifier Regulator.
Yes
Replace the battery, and then check the voltage of all electrical equipment on your boat.

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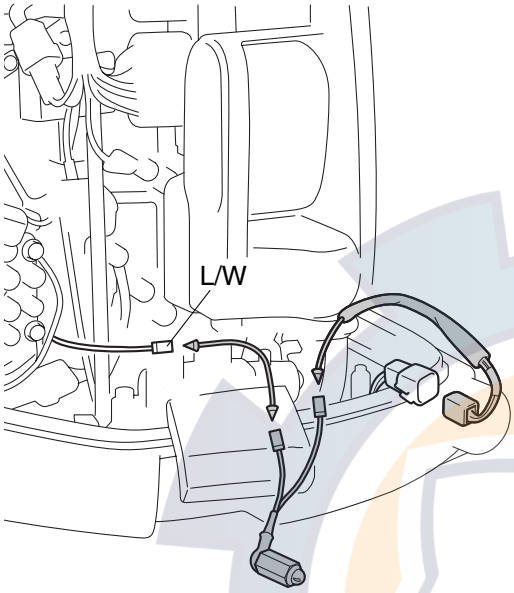
Self-diagnosis

Diagnosing the electronic control system

1. Connect the special service tool to the outboard motor as shown.



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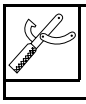
NOTE:
When performing this diagnosis, all of the electrical wires must be properly connected.

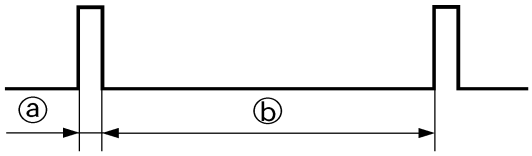
	Diagnostic test lead: YB-06795

2. Start the engine and let it idle.

3. Check the flash pattern of the special service tool to determine if there are any malfunctions.

   - Normal condition
     (no defective part or irregular processing is found)

   - Single flash is given every 4.95 seconds.
     ⓐ: Light on, 0.33 second
     ⓑ: Light off, 4.95 seconds



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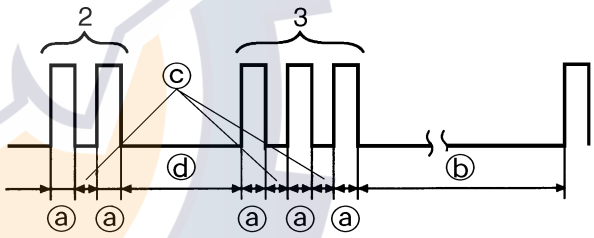
   - Trouble code indication
     Example: The illustration indicates code number 23.
     ⓐ: Light on, 0.33 second
     ⓑ: Light off, 4.95 seconds
     ⓒ: Light off, 0.33 second
     ⓓ: Light off, 1.65 seconds



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4. If a flash pattern listed in the diagnostic code chart is displayed, check the malfunctioning part according to the flash pattern.

NOTE:
When more than one problem is detected, the light of the special service tool flashes in the pattern of the lowest numbered problem. After that problem is corrected, the light flashes in the pattern of the next lowest numbered problem. This continues until all of the problems are detected and corrected.

Code	Symptom
1	Normal
13	Incorrect pulser coil signal
15	Incorrect cooling water temperature sensor signal
18	Incorrect throttle position sensor signal
19	Incorrect battery voltage
23	Incorrect sensor assembly (intake air temperature) signal
28	Incorrect shift position switch signal
29	Incorrect sensor assembly (intake air pressure) signal
37	Incorrect idle speed control signal
44	Incorrect engine stop lanyard switch signal
49	Over cool signal
59	Incorrect memory data signal

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A.

Adjusting the float 4-17
Adjusting the throttle link and throttle cable 3-8
Adjusting the trim sensor 7-21
After test run 1-9
Applicable model 1-5
Assembling the drive shaft 6-20
Assembling the forward gear 6-19
Assembling the fuel pump 4-6
Assembling the gear pump 7-33
Assembling the lower case 6-19
Assembling the oil pan 7-14
Assembling the oil pump 7-12
Assembling the power trim and tilt motor 7-29
Assembling the power trim and tilt unit 7-41
Assembling the power unit 5-49
Assembling the propeller shaft assembly 6-12
Assembling the propeller shaft housing 6-13
Assembling the tilt cylinder 7-39
Assembling the upper case 7-15
Assembling the vapor separator 4-16

B.

Backlash 6-28
Bleeding the power trim and tilt unit 7-43
Bleeding the power trim and tilt unit (built-in) 7-44
Bottom cowling 7-3
Bow view 8-5
Bracket unit 3-11, 9-13
Break-in 1-9

C.

Canister 4-18
Changing the engine oil by draining it 3-4
Changing the engine oil using an oil changer 3-4
Changing the gear oil 3-12
Charging system 8-16
Checking the anodes 3-14
Checking the armature 8-15
Checking the battery 1-7, 3-14
Checking the bearings 6-18
Checking the brushes 8-16
Checking the camshafts 5-31
Checking the canister 4-19
Checking the compression pressure 5-3
Checking the connecting rod big end side clearance 5-43
Checking the cooling water passage 3-8
Checking the cooling water pilot hole 1-9
Checking the cooling water temperature sensor 8-9
Checking the crankpin oil clearance 5-43
Checking the crankshaft 5-43
Checking the crankshaft journal oil clearance 5-46
Checking the cylinder bore 5-41
Checking the cylinder head 5-32
Checking the diaphragm and valves 4-6
Checking the drive shaft 6-18
Checking the drive shaft bushing 7-13
Checking the ECM 8-8
Checking the electric fuel pump 8-10
Checking the electrical components 8-2
Checking the engine idle speed 3-8
Checking the engine oil 3-4
Checking the engine oil level 1-6
Checking the engine start switch and engine stop lanyard switch 1-8
Checking the fuel filter 3-3
Checking the fuel joint and fuel hoses (fuel joint-to-fuel injector) 3-3
Checking the fuel pump 4-5
Checking the fuel system 1-6
Checking the fuse 7-45
Checking the fuses 8-11
Checking the gear oil level 1-7, 3-12
Checking the gear pump 7-33
Checking the gear shift and throttle operation 1-8
Checking the gear shift operation 3-10
Checking the idle speed control 4-9
Checking the ignition coils 8-7
Checking the ignition spark 8-7
Checking the injectors 8-10
Checking the lower case 6-18
Checking the lower unit for air leakage 3-13
Checking the magnet switch 8-16
Checking the main and fuel pump relay (fuel control) 8-11
Checking the main and fuel pump relay (main control) 8-10
Checking the oil pressure 5-3
Checking the oil pressure switch 8-9
Checking the oil pump 7-12
Checking the oil strainer 7-14
Checking the outboard motor mounting height 1-7
Checking the pinion and forward gear 6-18
Checking the piston clearance 5-41
Checking the piston diameter 5-40
Checking the piston ring grooves 5-42

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Checking the piston ring side clearance ...5-42
Checking the piston rings.....5-41
Checking the power trim and tilt fluid level.....3-11
Checking the power trim and tilt motor 7-27
Checking the power trim and tilt operation.....3-11
Checking the power trim and tilt relay.....7-45
Checking the power trim and tilt switch.....7-46
Checking the power trim and tilt system 1-8
Checking the pressure control valve.....5-38
Checking the pressure regulator.....4-14
Checking the propeller.....3-13
Checking the propeller shaft.....6-12
Checking the propeller shaft housing.....6-12
Checking the pulser coils.....8-8
Checking the Rectifier Regulator.....8-17
Checking the remote control cables.....1-7
Checking the sensor assembly.....8-8
Checking the shift position switch.....8-9
Checking the spark plug wires.....8-7
Checking the spark plugs.....3-6
Checking the starter motor operation.....8-16
Checking the starter motor pinion.....8-15
Checking the starter relay.....8-11
Checking the stator coil.....8-16
Checking the steering system.....1-8
Checking the thermostat.....3-7
Checking the throttle position sensor.....4-9
Checking the tilt cylinder and trim cylinder.....7-39
Checking the timing belt.....3-6
Checking the timing belt and sprockets 5-18
Checking the top cowling.....3-3
Checking the trim sensor.....7-46
Checking the valve clearance.....5-10
Checking the valve guides.....5-28
Checking the valve lifters.....5-27
Checking the valve seat.....5-29
Checking the valve springs.....5-27
Checking the valves..... 5-27, 7-39
Checking the vapor separator.....4-16
Checking the water pump and shift rod 6-9
Clamp brackets and swivel bracket 7-19
Control system.....3-8
Cylinder block.....5-39
Cylinder head.....5-24

D.

Diagnosing the electronic control system.....9-18
Dimensions.....2-9
Disassembling the cylinder block.....5-40
Disassembling the drive shaft.....6-17
Disassembling the forward gear.....6-17
Disassembling the fuel pump 4-5
Disassembling the gear pump.....7-33
Disassembling the lower case.....6-17
Disassembling the oil pan.....7-13
Disassembling the oil pump.....7-12
Disassembling the oil seal housing 6-9
Disassembling the power trim and tilt motor 7-27
Disassembling the propeller shaft assembly 6-11
Disassembling the propeller shaft housing.....6-11
Disassembling the starter motor.....8-15
Disassembling the tilt cylinder 7-38
Disassembling the trim cylinder.....7-38
Disassembling the upper case 7-13
Disassembling the vapor separator.....4-15
Disassembly and assembly.....1-4
Disconnecting the quick connector.....4-13
Draining the fuel 4-15
Drive shaft and lower case 6-15

E.

ECM.....5-21
Electrical.....2-6
Electrical components 8-3
Electrical systems.....9-17
Exhaust cover.....5-36

F.

Fire prevention.....1-3
Fuel and blowby hoses.....4-2
Fuel control system 8-10
Fuel filter and fuel pump 4-3
Fuel system 3-3

G.

Gear pump.....7-30
General.....3-14
General specifications 2-1
General torques.....2-13
Good working practices 1-4

H.

Hose routing 4-2
How to use this manual 1-1

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I.

Identification 1-5
Ignition and ignition control system 8-7
Installing the clamp brackets 7-21
Installing the cylinder head 5-33
Installing the drive shaft 6-20
Installing the exhaust cover 5-38
Installing the fuel hose clamp 4-15
Installing the lower unit 6-22
Installing the power trim and tilt unit 7-44
Installing the power unit 5-51
Installing the pressure control valve 5-38
Installing the propeller shaft housing 6-20
Installing the sprockets and timing belt 5-18
Installing the steering arm 7-18
Installing the throttle position sensor 4-9
Installing the upper case 7-15
Installing the valves 5-33
Installing the water pump and shift rod 6-21
Intake manifold 4-7
Introduction 9-2

J.

Junction box 5-22

L.

Lower unit 2-6, 3-12, 6-4
Lubricating the outboard motor 3-15

M.

Maintenance interval chart 3-2
Maintenance specification 2-3
Manual format 1-1
Measuring the forward gear backlash 6-28
Measuring the fuel pressure 4-13
Measuring the lower resistance 8-2
Measuring the peak voltage 8-2

P.

Parts, lubricants, and sealants 1-3
Port view 8-3
Power trim and tilt electrical system 7-45
Power trim and tilt motor 7-25
Power trim and tilt unit 7-23
Power unit 2-3, 3-4, 5-3, 9-5
Predelivery checks 1-6
Propeller selection 1-5
Propeller shaft housing 6-10
Propeller size 1-5

R.

Reducing the fuel pressure 4-13
Refacing the valve seat 5-30
Removing the clamp brackets 7-21
Removing the cylinder head 5-26
Removing the drive shaft 6-17
Removing the exhaust cover 5-38
Removing the fuel hose clamp 4-15
Removing the lower unit 6-8
Removing the power trim and tilt unit 7-24
Removing the power unit 5-16
Removing the propeller shaft housing assembly 6-11
Removing the steering arm 7-18
Removing the timing belt and sprockets 5-17
Removing the upper case 7-12
Removing the water pump and shift rod 6-9
Replacing the oil filter 3-5
Replacing the timing belt 5-13
Replacing the valve guides 5-28

S.

Safety while working 1-3
Selecting the connecting rod bearing 5-45
Selecting the forward gear shims 6-27
Selecting the main bearing 5-47
Selecting the pinion shims 6-26
Selection 1-6
Self-diagnosis 9-18
Self-protection 1-3
Serial number 1-5
Shift rod 7-2
Shimming 6-25, 6-26
Special service tools 3-1, 4-1, 5-1, 6-1, 7-1, 8-1, 9-1
Specified torques 2-11
Starboard view 8-4
Starter motor 8-13
Starting system 8-11
Steering arm 7-17
Symbols 1-2

T.

Test run 1-9
Throttle link 5-20
Tightening torques 2-11
Tilt cylinder and trim cylinder 7-35
Top cowling 3-3
Top view 8-6

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U.

Upper case.....7-6

V.

Vapor separator 4-10
Ventilation 1-3

Y.

Yamaha Diagnostic System.....9-2

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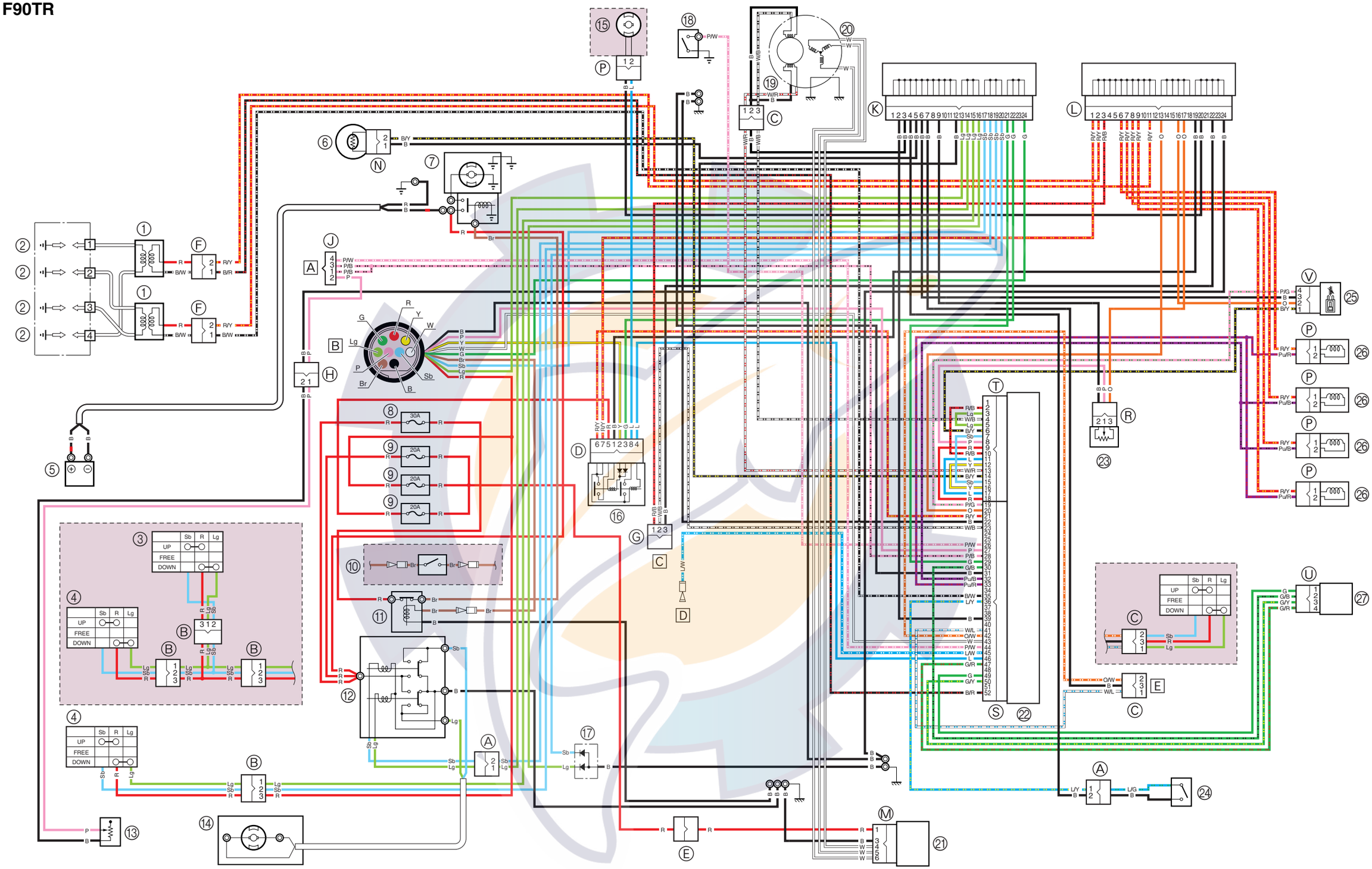
F90TR



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Wiring diagram
F90TR

① Ignition coil
② Spark plug
③ Power trim and tilt switch (tiller handle) (optional)
④ Power trim and tilt switch (bottom cowling)
⑤ Battery
⑥ Cooling water temperature sensor
⑦ Starter motor
⑧ Fuse (30 A)
⑨ Fuse (20 A)
⑩ Neutral switch (optional)
⑪ Starter relay
⑫ Power trim and tilt relay
⑬ Trim sensor
⑭ Power trim and tilt motor
⑮ Electric fuel pump
⑯ Main and fuel pump relay
⑰ Diode
⑱ Oil pressure switch
⑲ Pulser coil
⑳ Stator coil
㉑ Rectifier Regulator
㉒ ECM
㉓ Throttle position sensor
㉔ Shift position switch
㉕ Sensor assembly
㉖ Fuel injector
㉗ Idle speed control
㉘ Variable trolling RPM switch (optional)

Ⓐ To warning indicator/trim meter
Ⓑ To remote control box/switch panel
Ⓒ To personal computer for diagnosis
Ⓓ To diagnostic flash indicator (special service tool)
Ⓔ To Variable trolling RPM switch

Color code

B	: Black
Br	: Brown
G	: Green
L	: Blue
Lg	: Light green
O	: Orange
P	: Pink
R	: Red
Sb	: Sky blue
W	: White
Y	: Yellow
B/R	: Black/red
B/W	: Black/white
B/Y	: Black/yellow
Br/W	: Brown/white
G/B	: Green/black
G/R	: Green/red
G/Y	: Green/yellow
L/G	: Blue/green
L/W	: Blue/white
L/Y	: Blue/yellow
O/W	: Orange/white
P/B	: Pink/black
P/G	: Pink/green
P/W	: Pink/white
Pu/B	: Purple/black
Pu/R	: Purple/red
R/B	: Red/black
R/Y	: Red/yellow
W/B	: White/black
W/L	: White/blue
W/R	: White/red

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